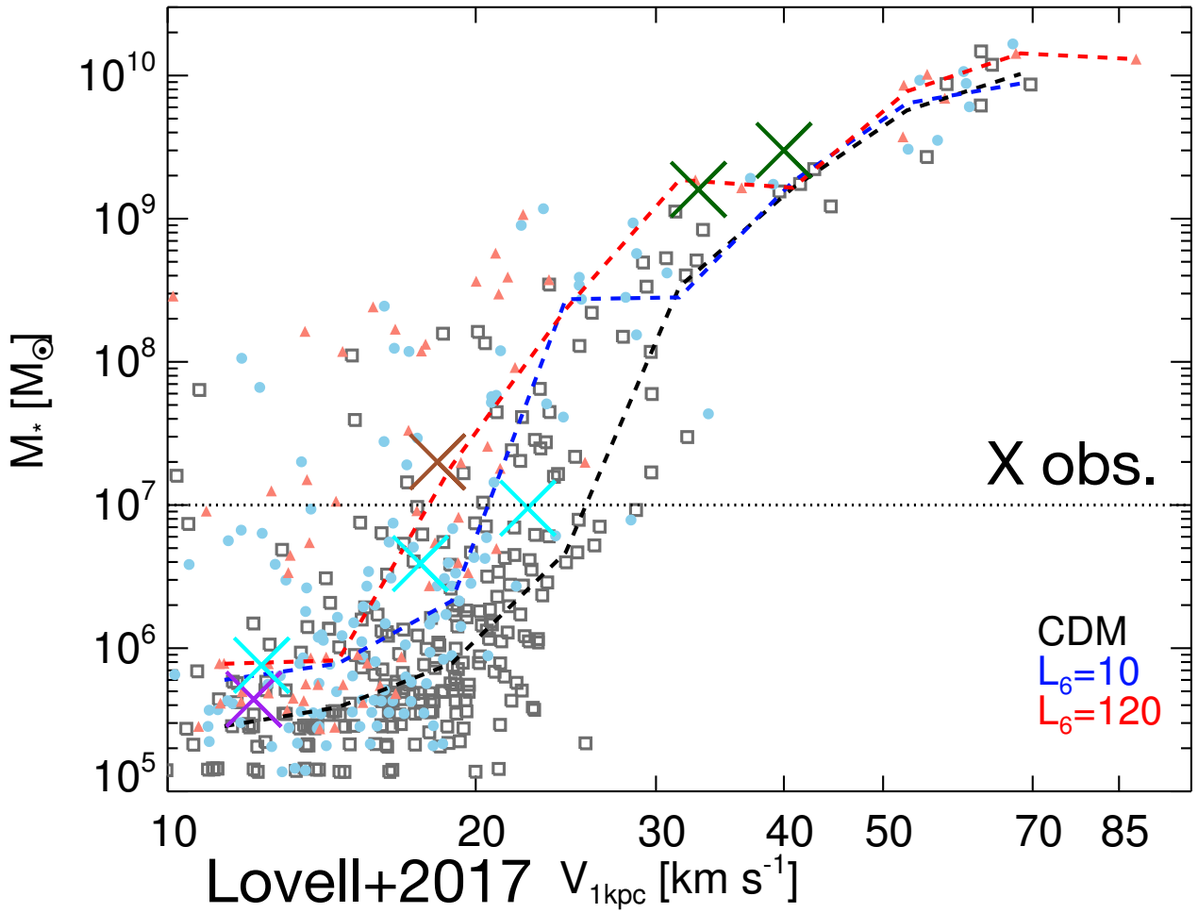
Star formation in alternative dark matter dwarfs: then and now

Mark R. Lovell[⋆1,2], Jesús Zavala[1]+ ([1]University of Iceland, [2]Durham, *lovell@hi.is)

DOI:[10.1093/mnras/stz766 , 10.1093/mnras/sty818]

Power spectrum cutoff: low redshift



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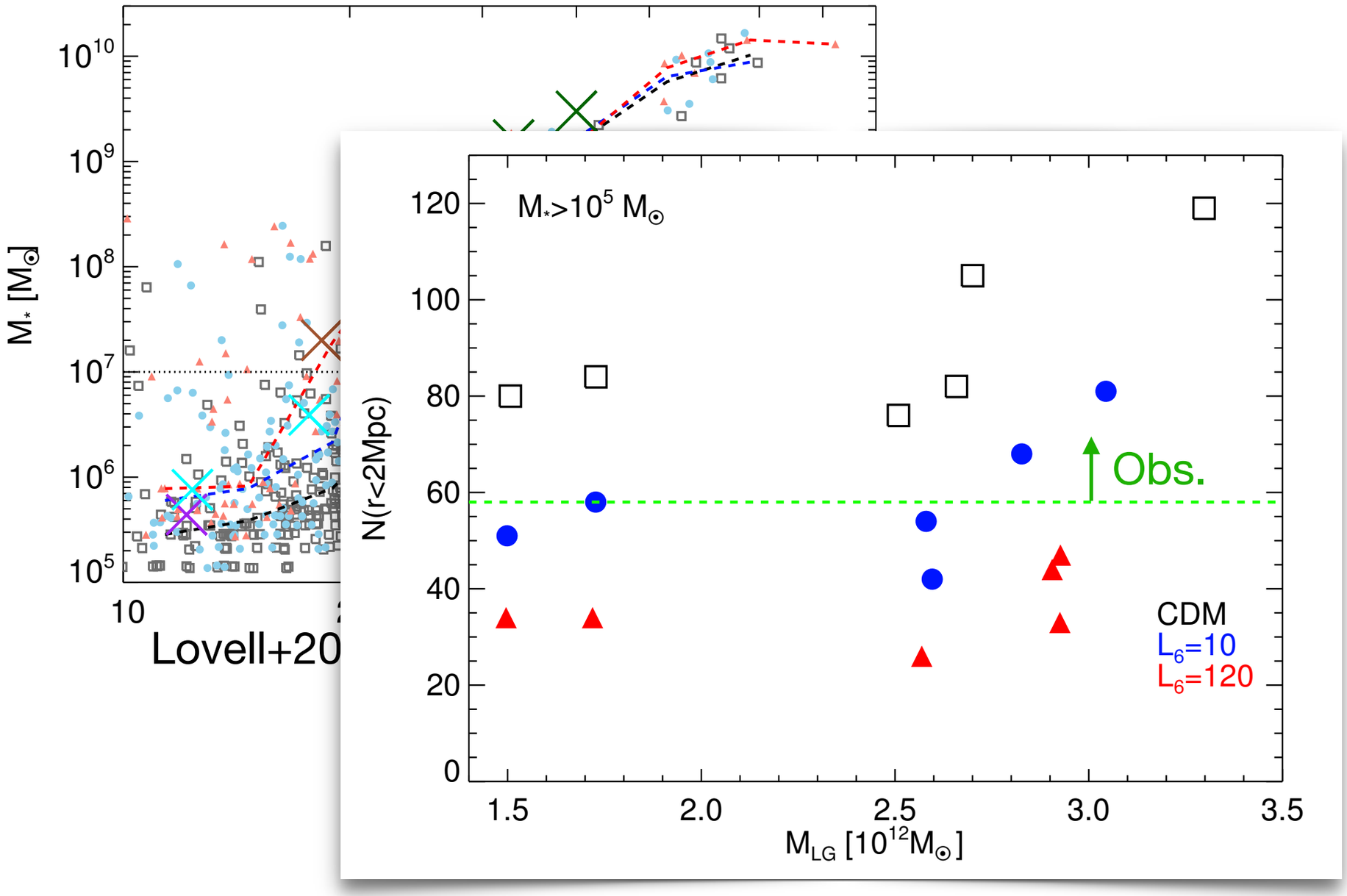

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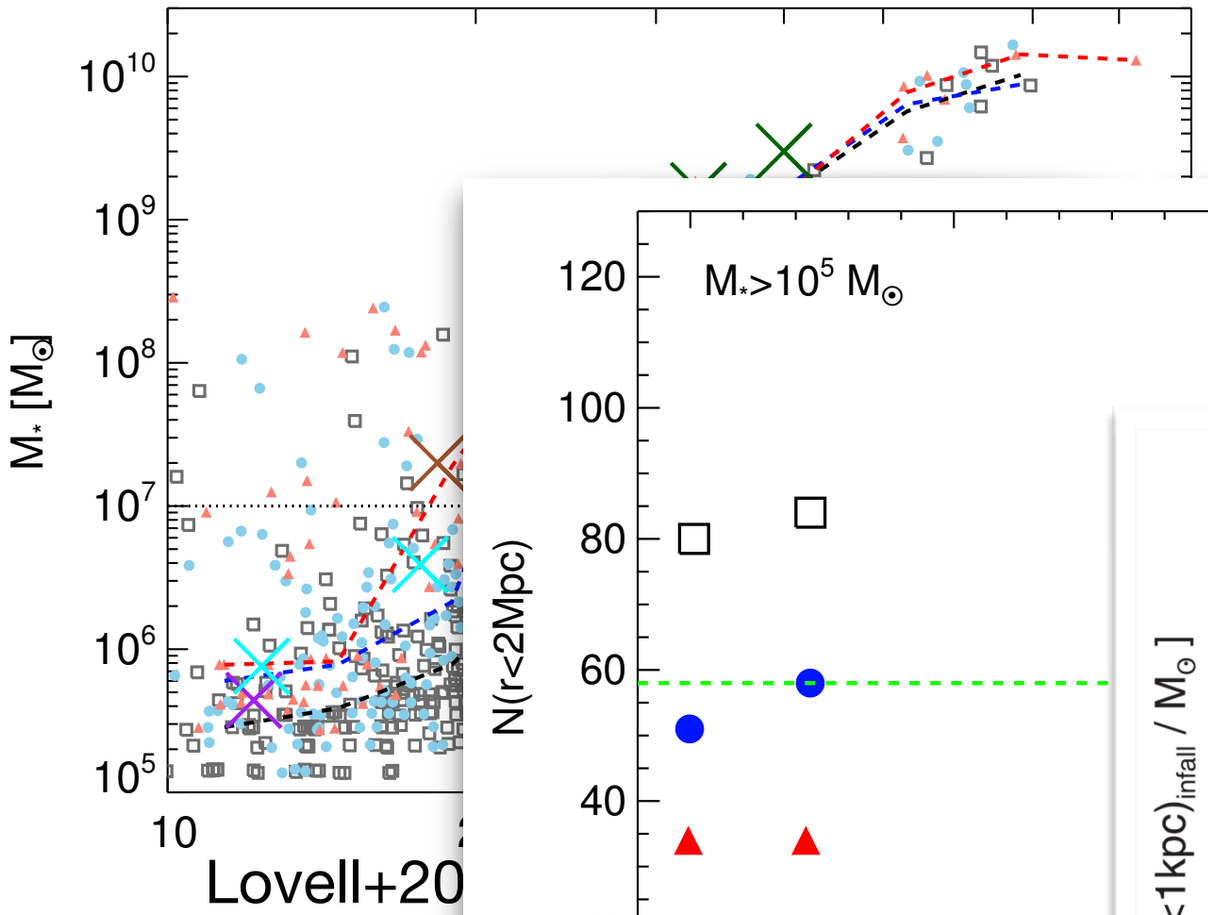

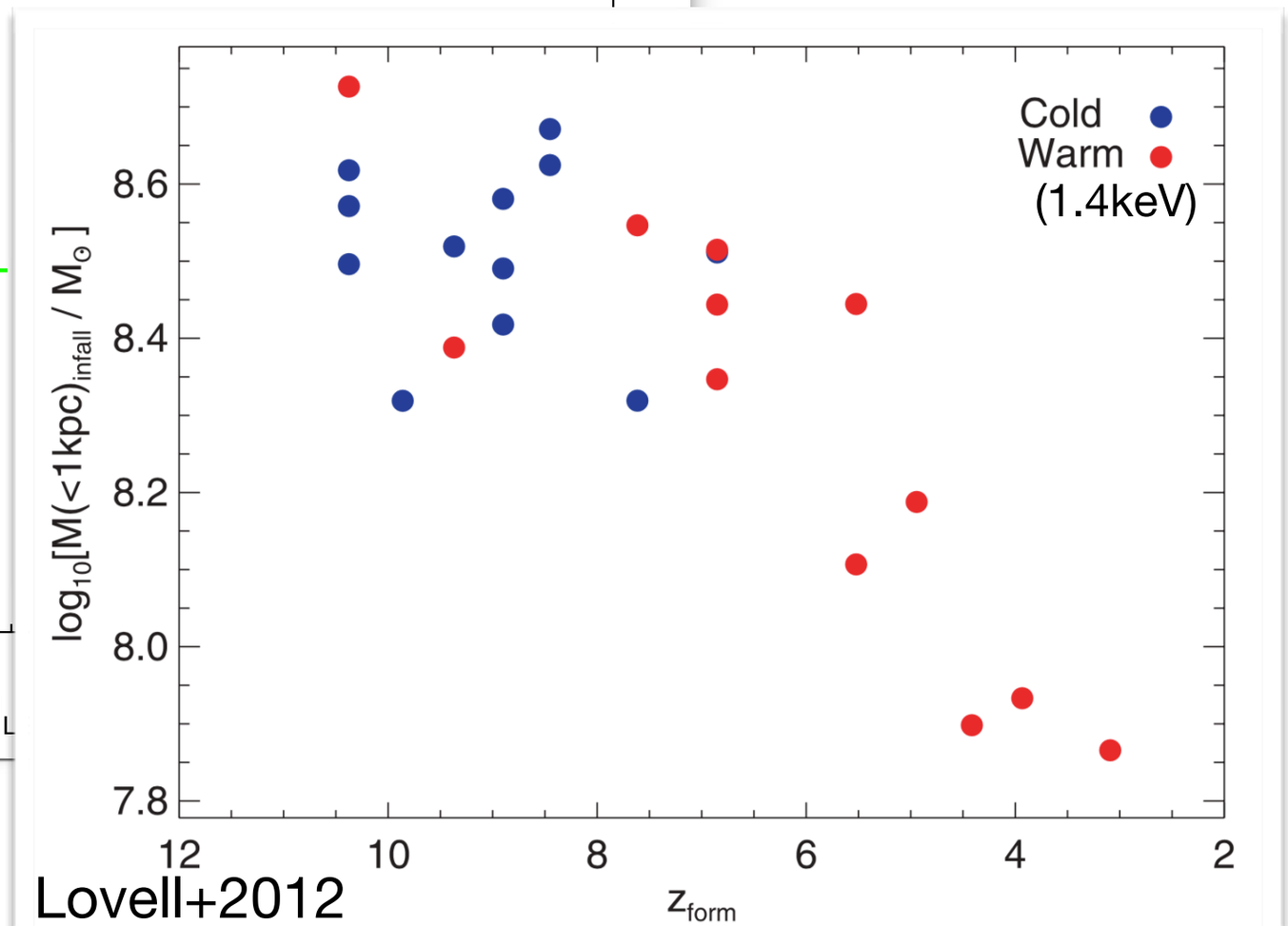

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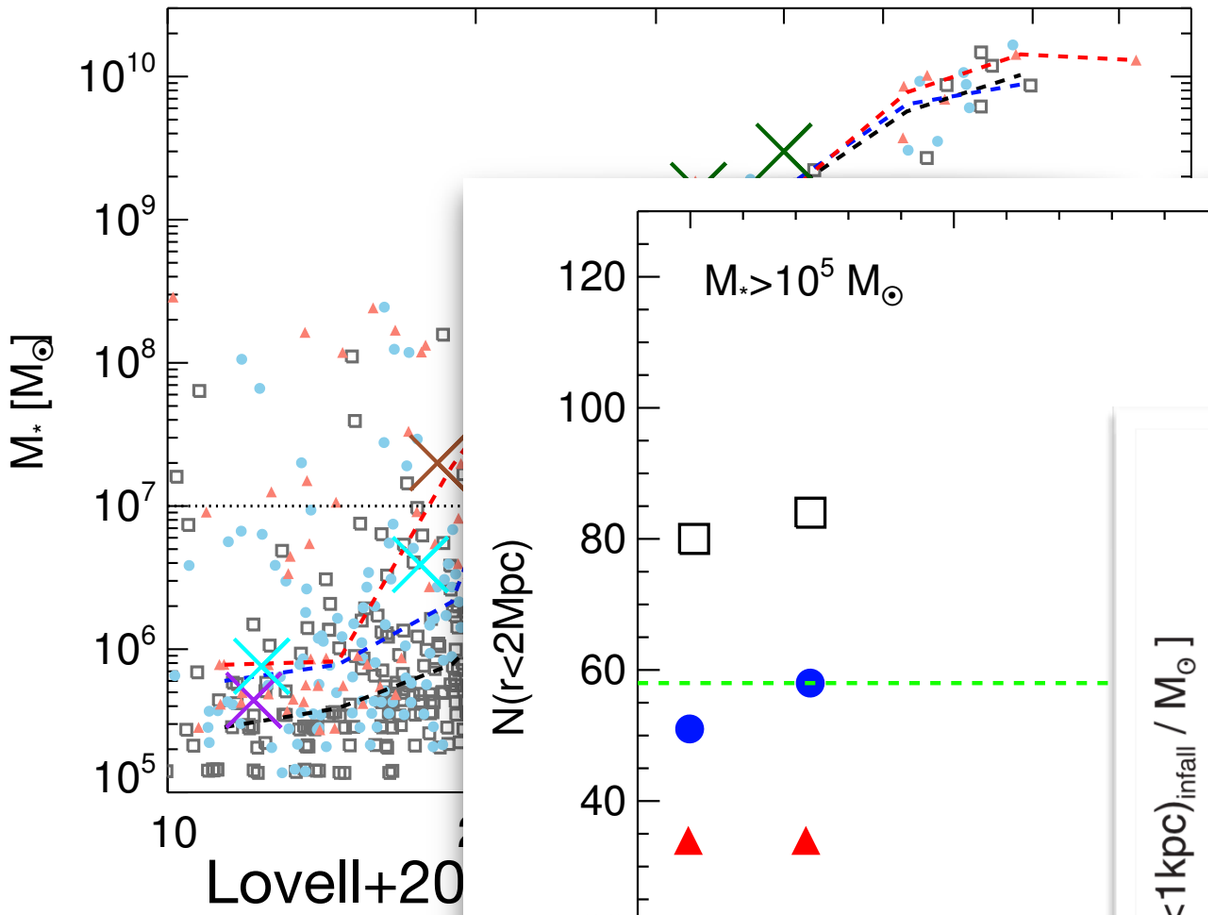
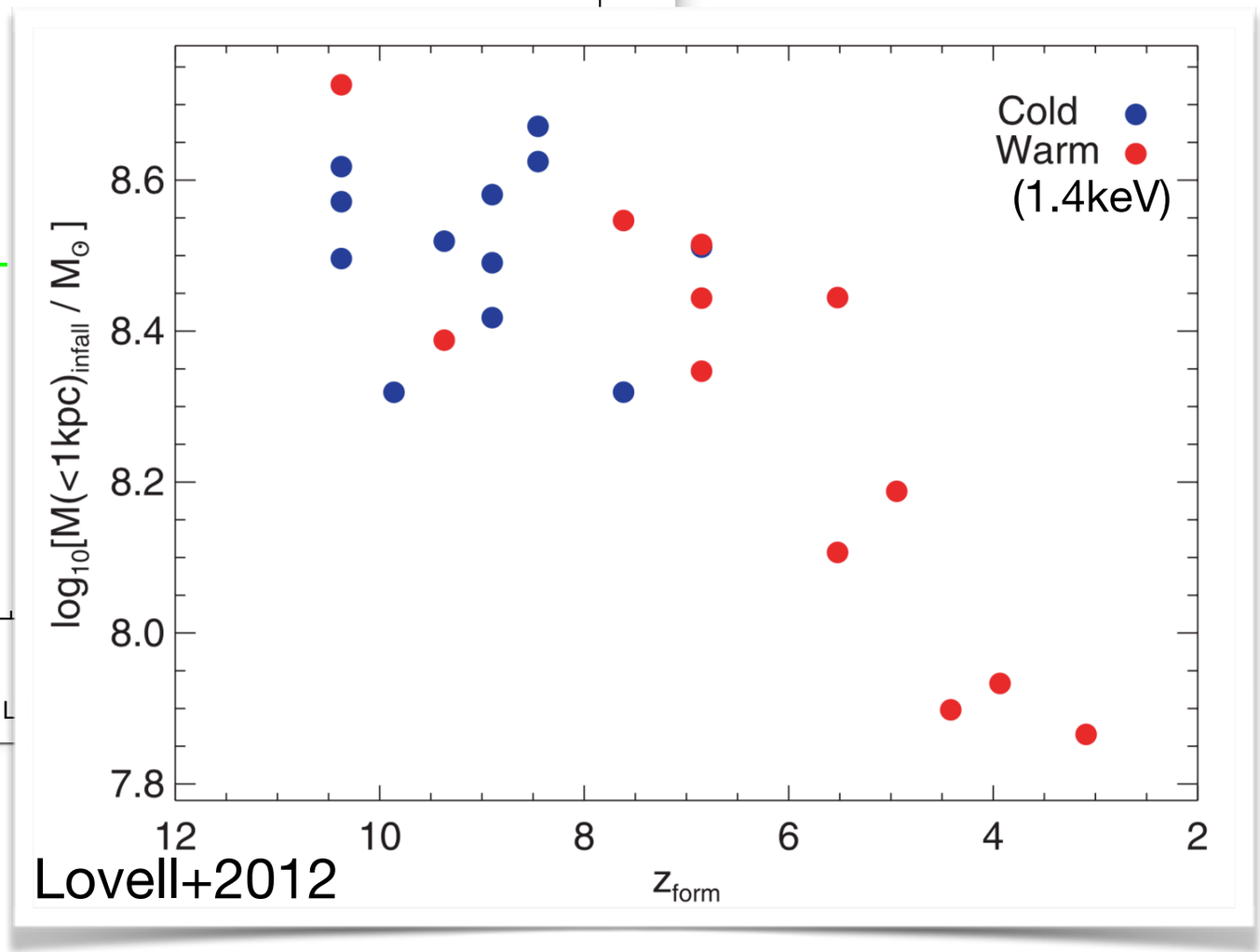
Power spectrum cutoff: low redshift

How is halo/galaxy formation different at high redshifts?
How about the oldest stars?





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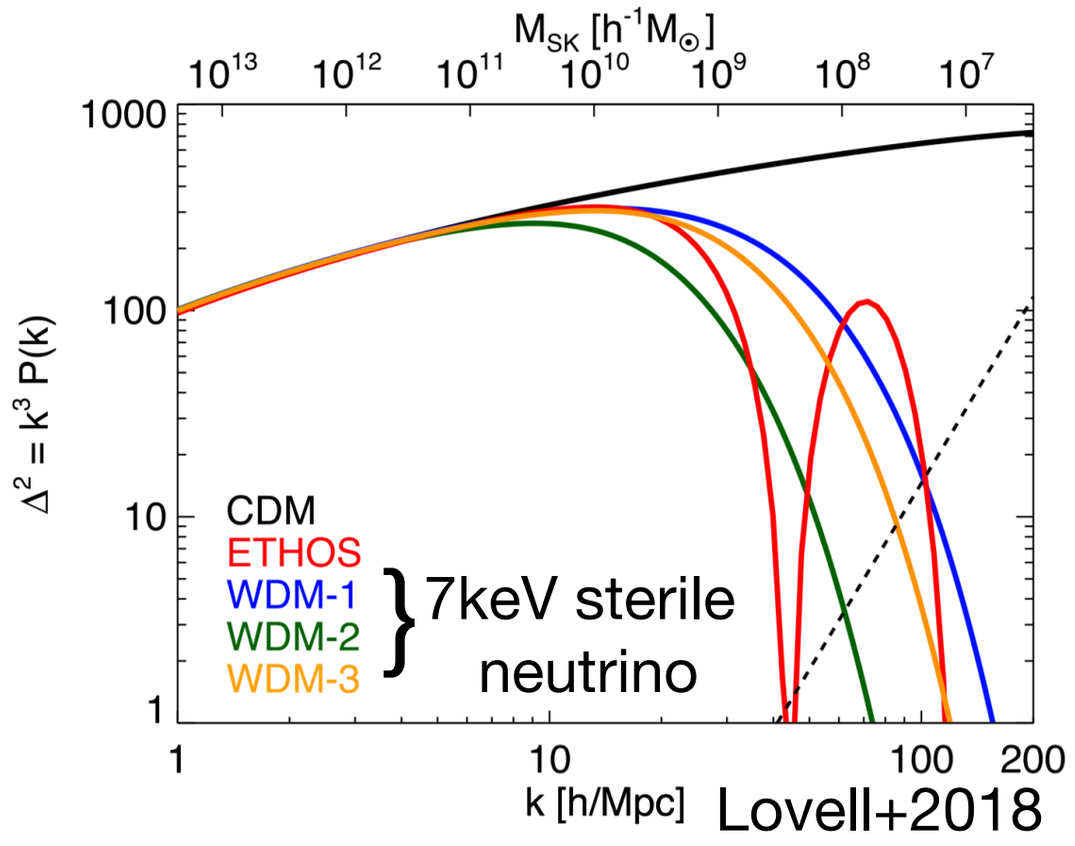
The simulations

- Full hydro, SF, supernova feedback
- ETHOS model: self-interactions + dark acoustic oscillations
- Particle mass: 1.76 × 10^6Msun
- Box size: 25Mpc/h
- Run to z=6



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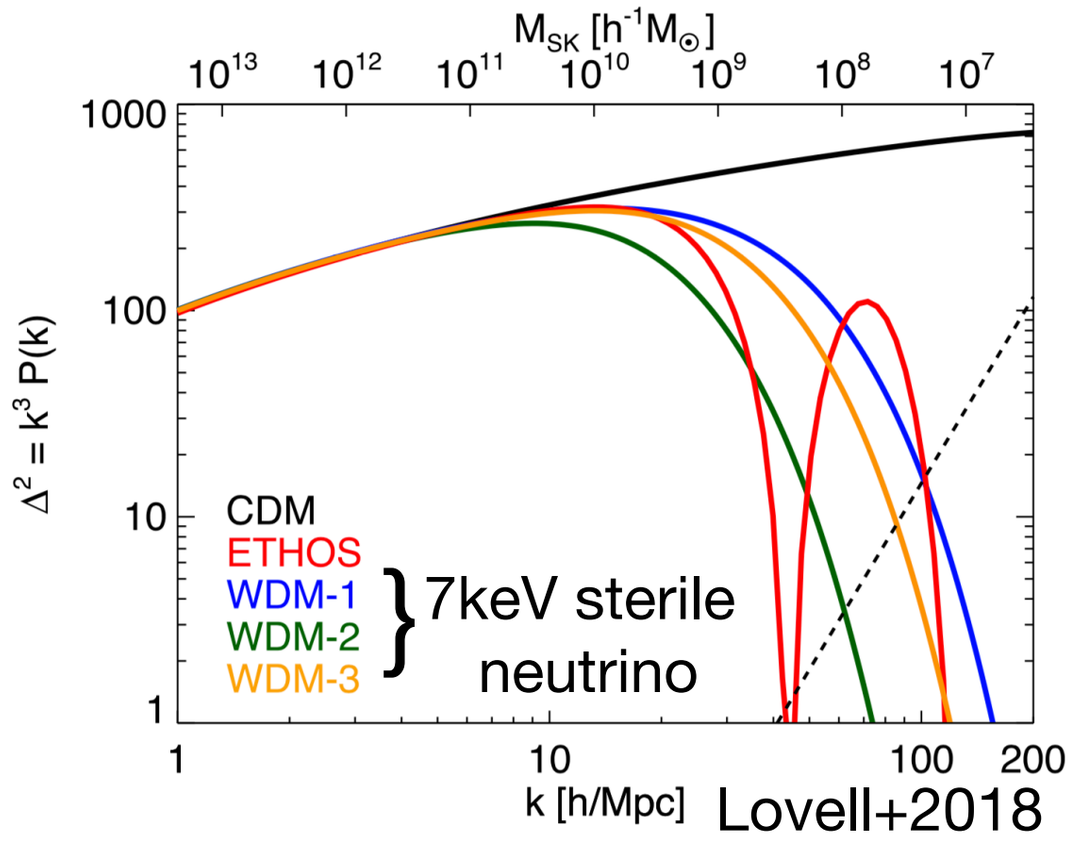
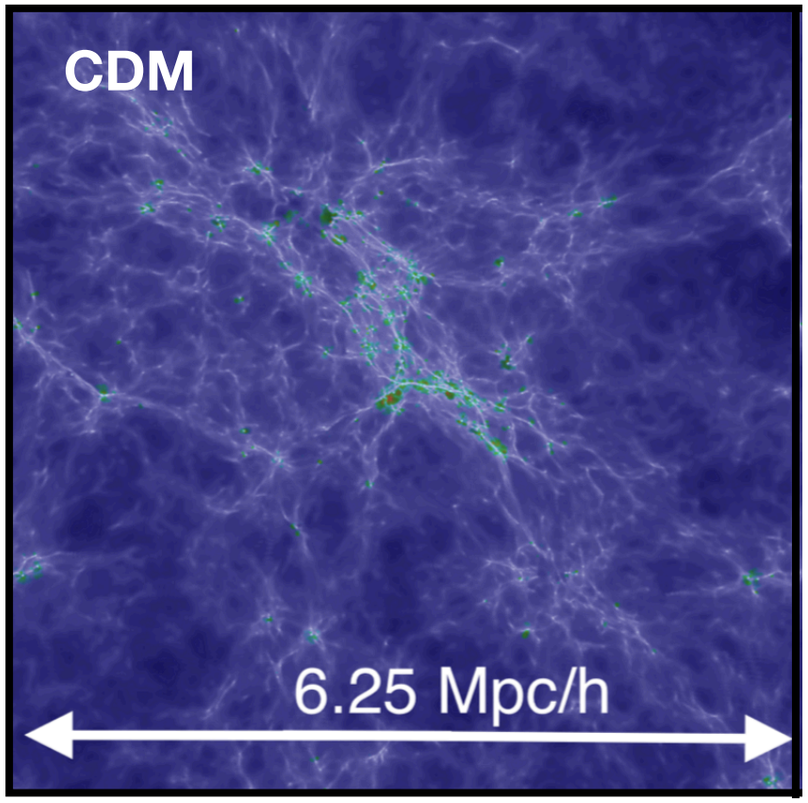


Temperature map



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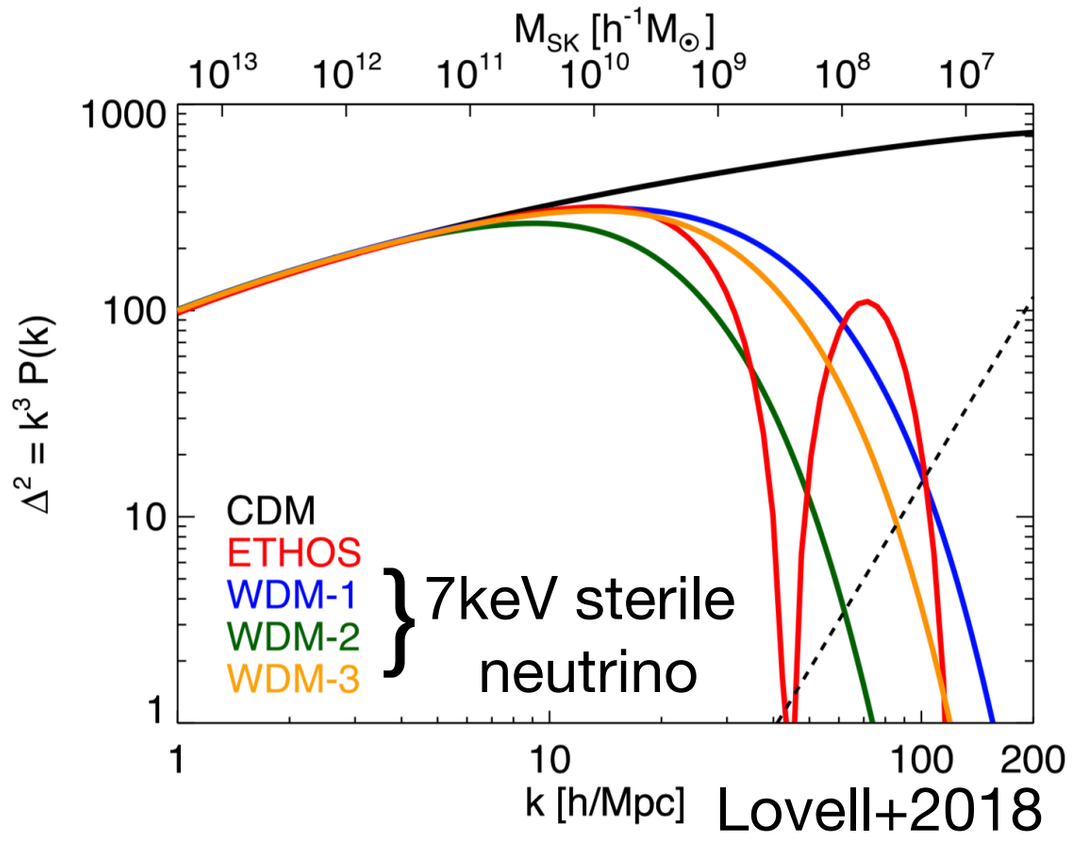

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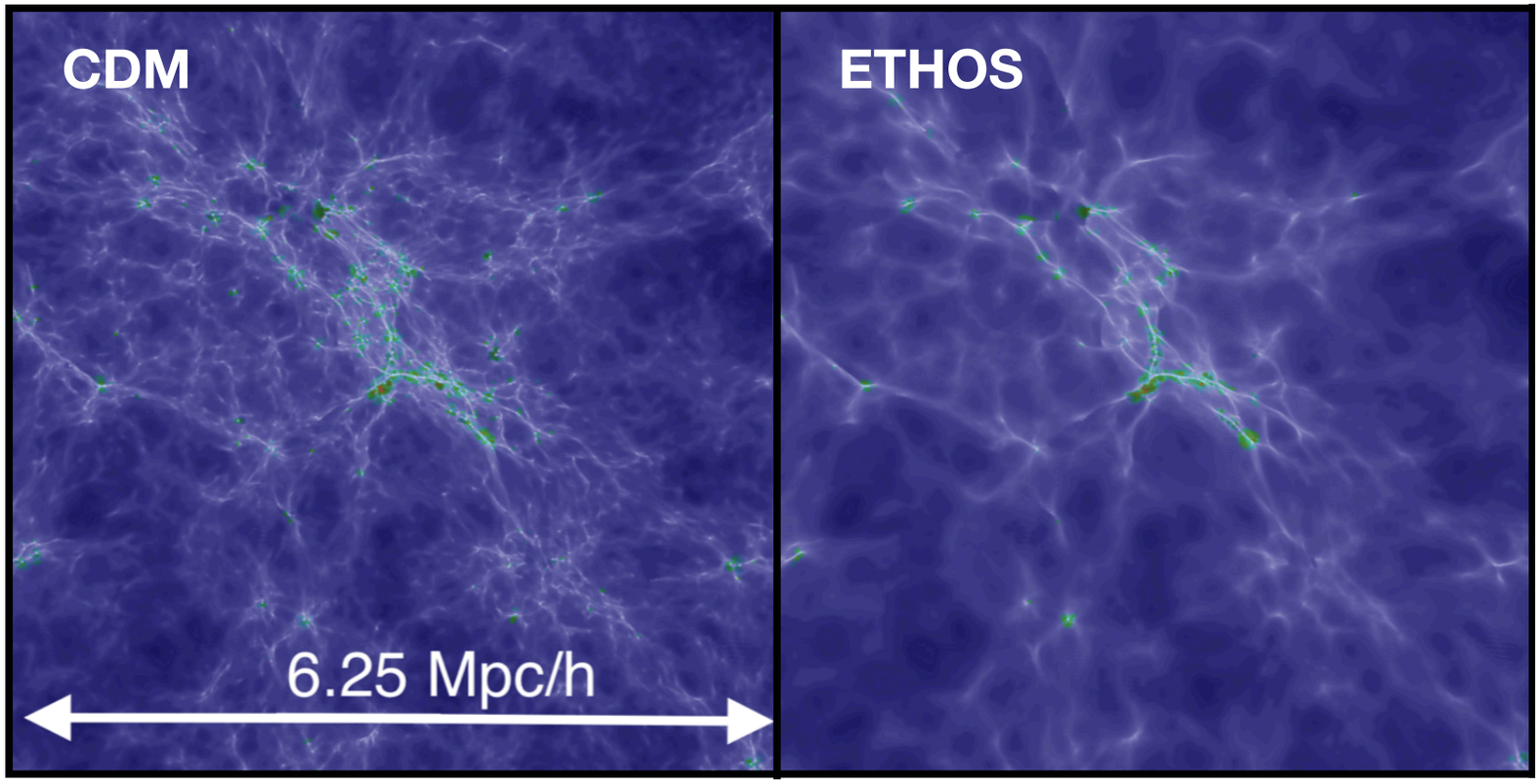

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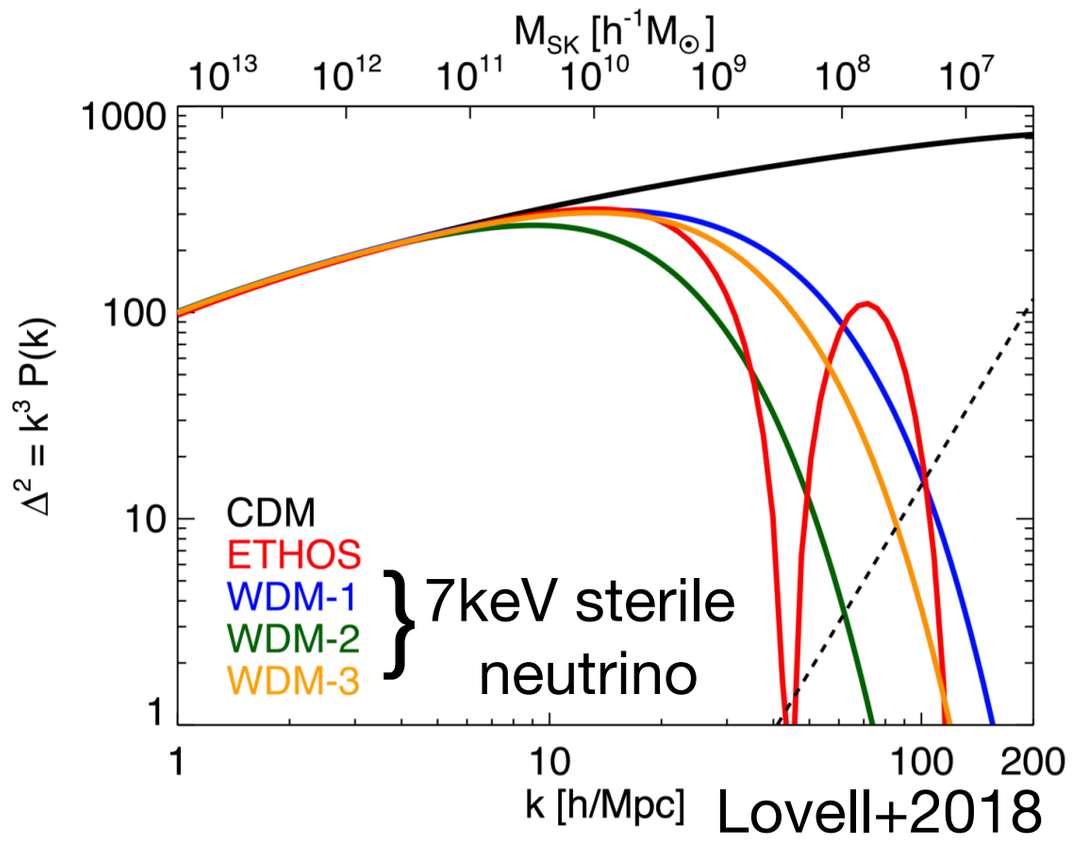

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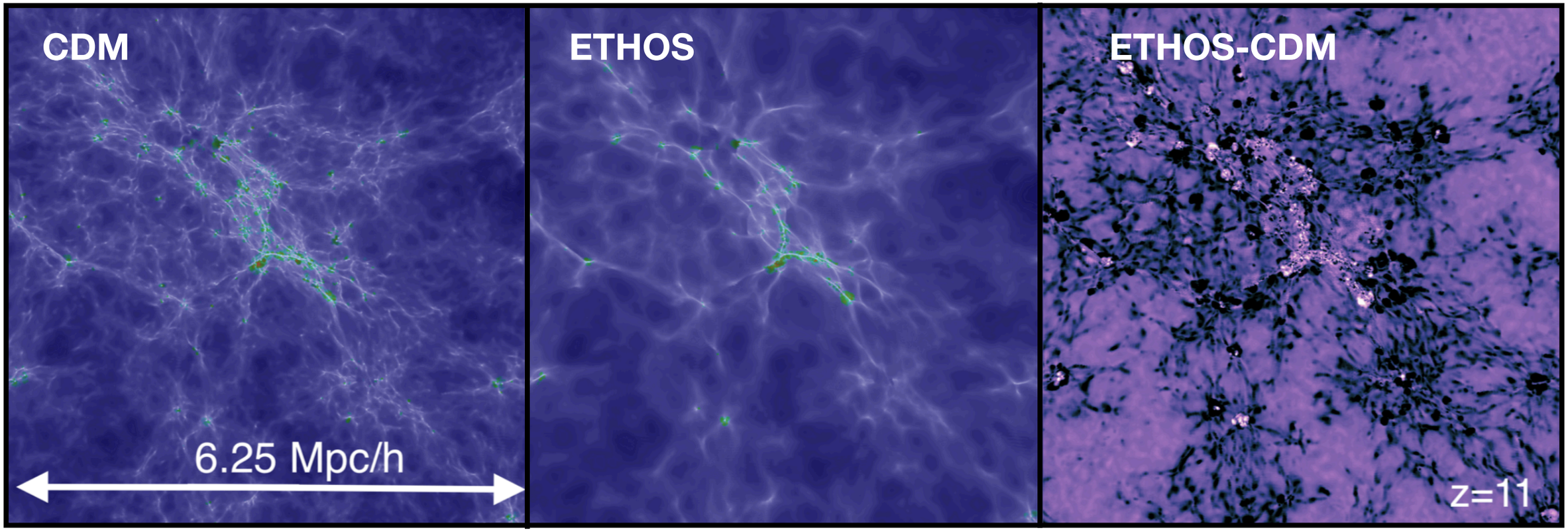

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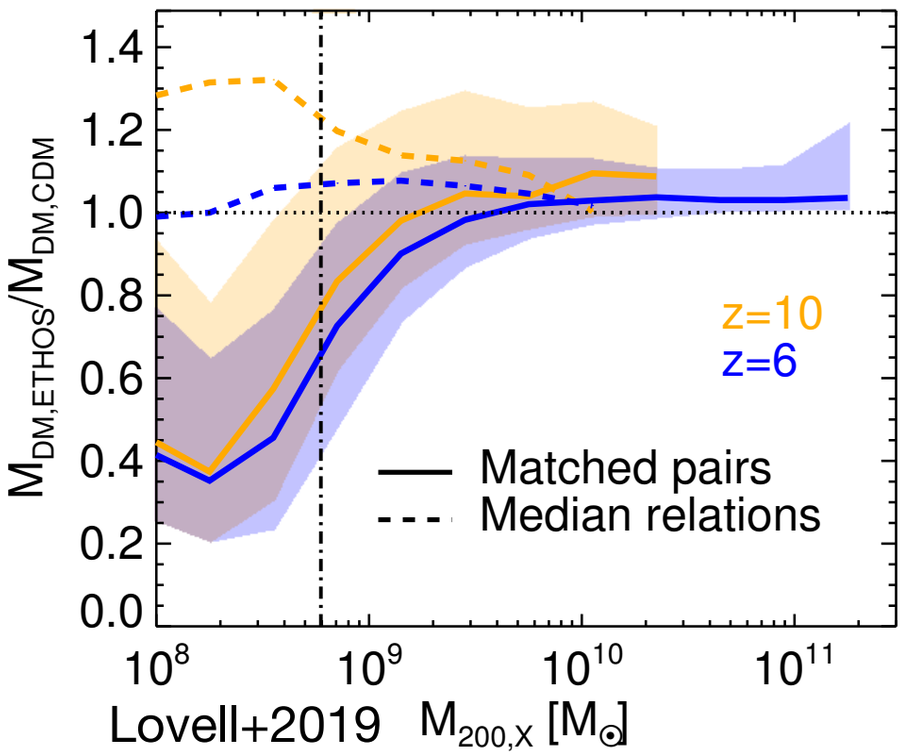
ETHOS vs. CDM — change in DM mass / gas mass

Bound DM mass



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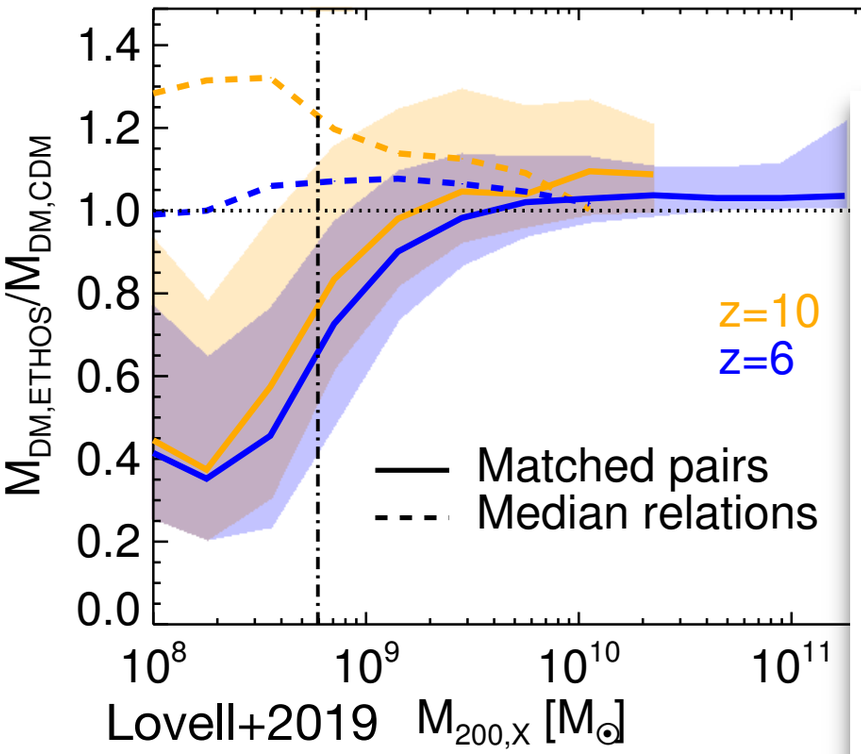
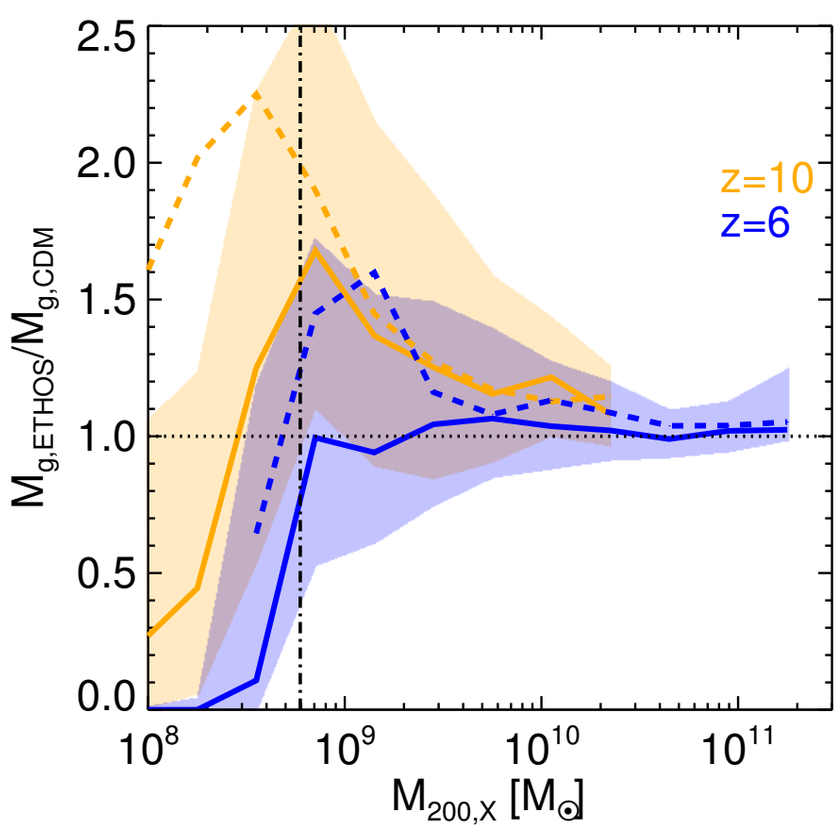


Bound gas mass



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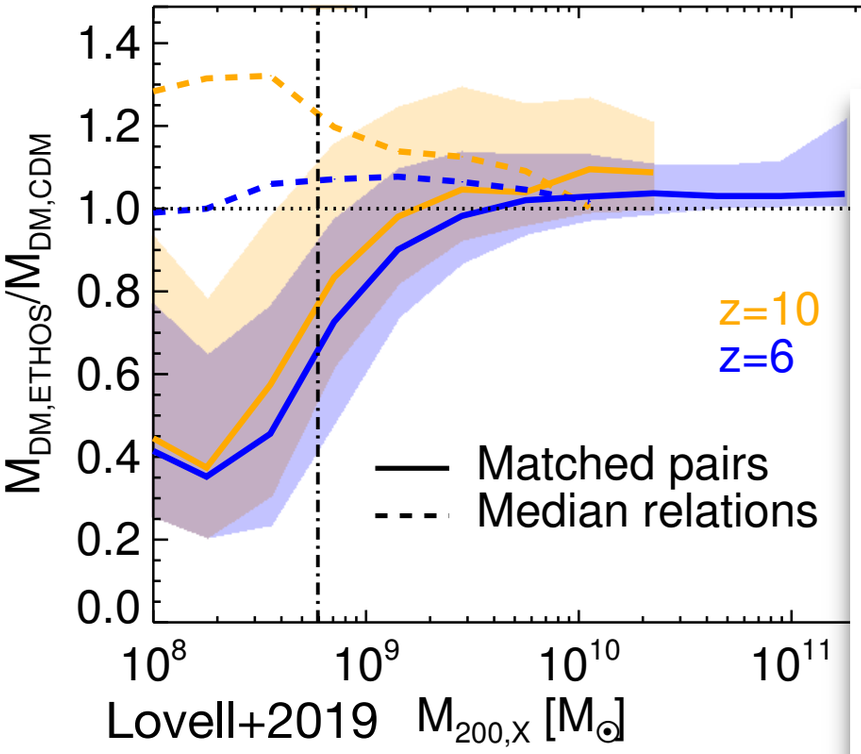
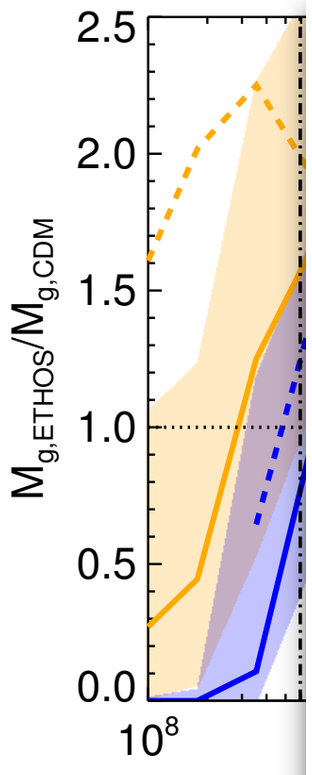
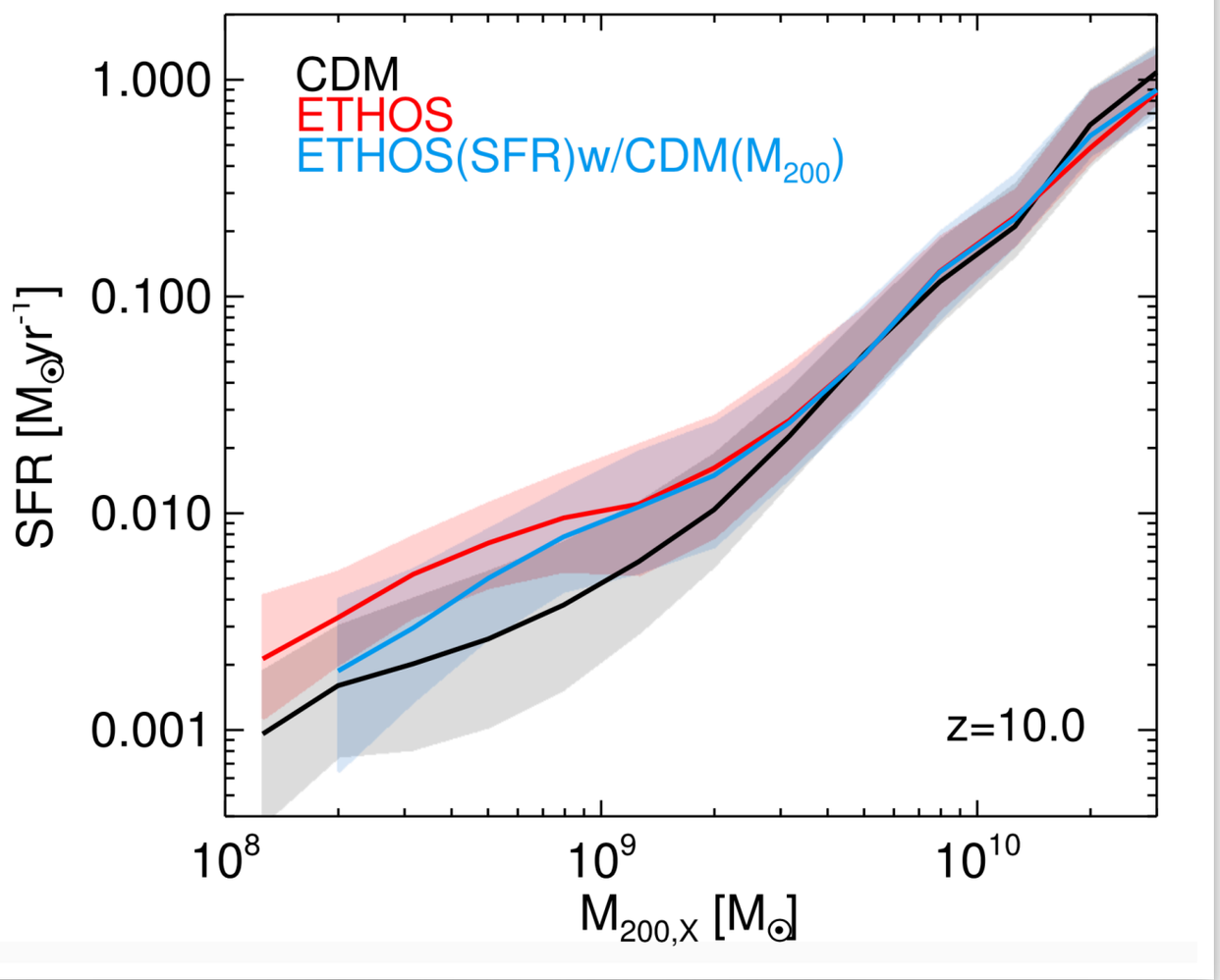


Bound gas mass



SFR



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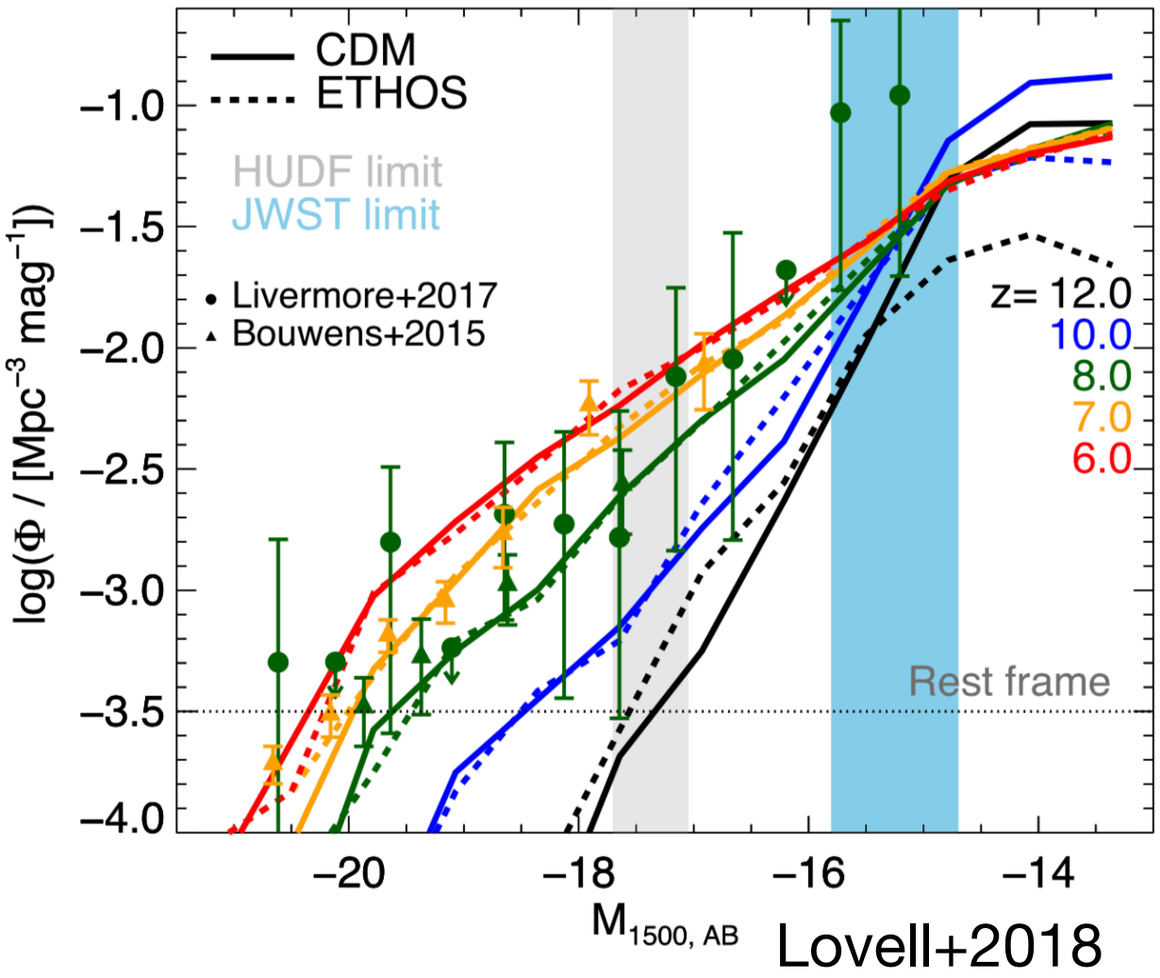
The galaxy population & reionisation



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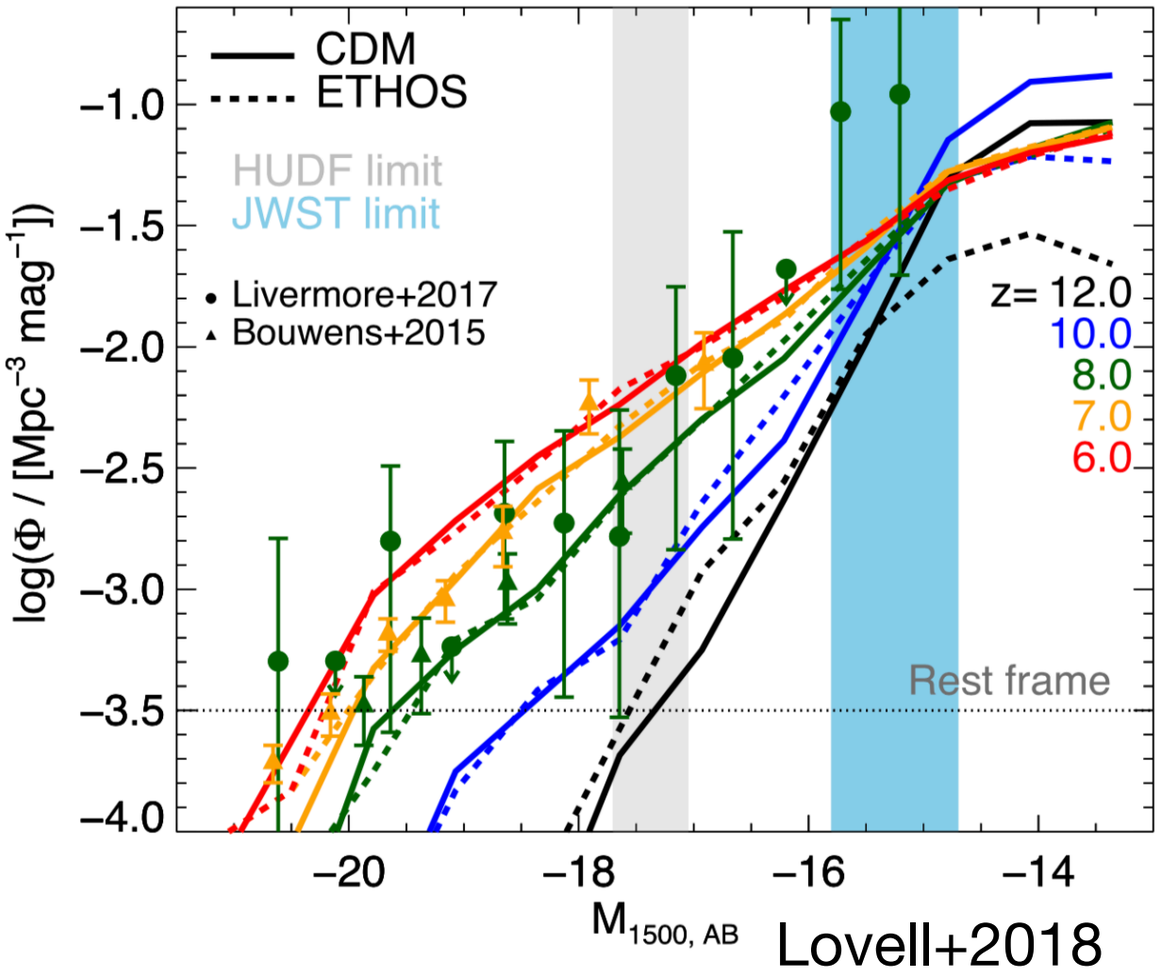

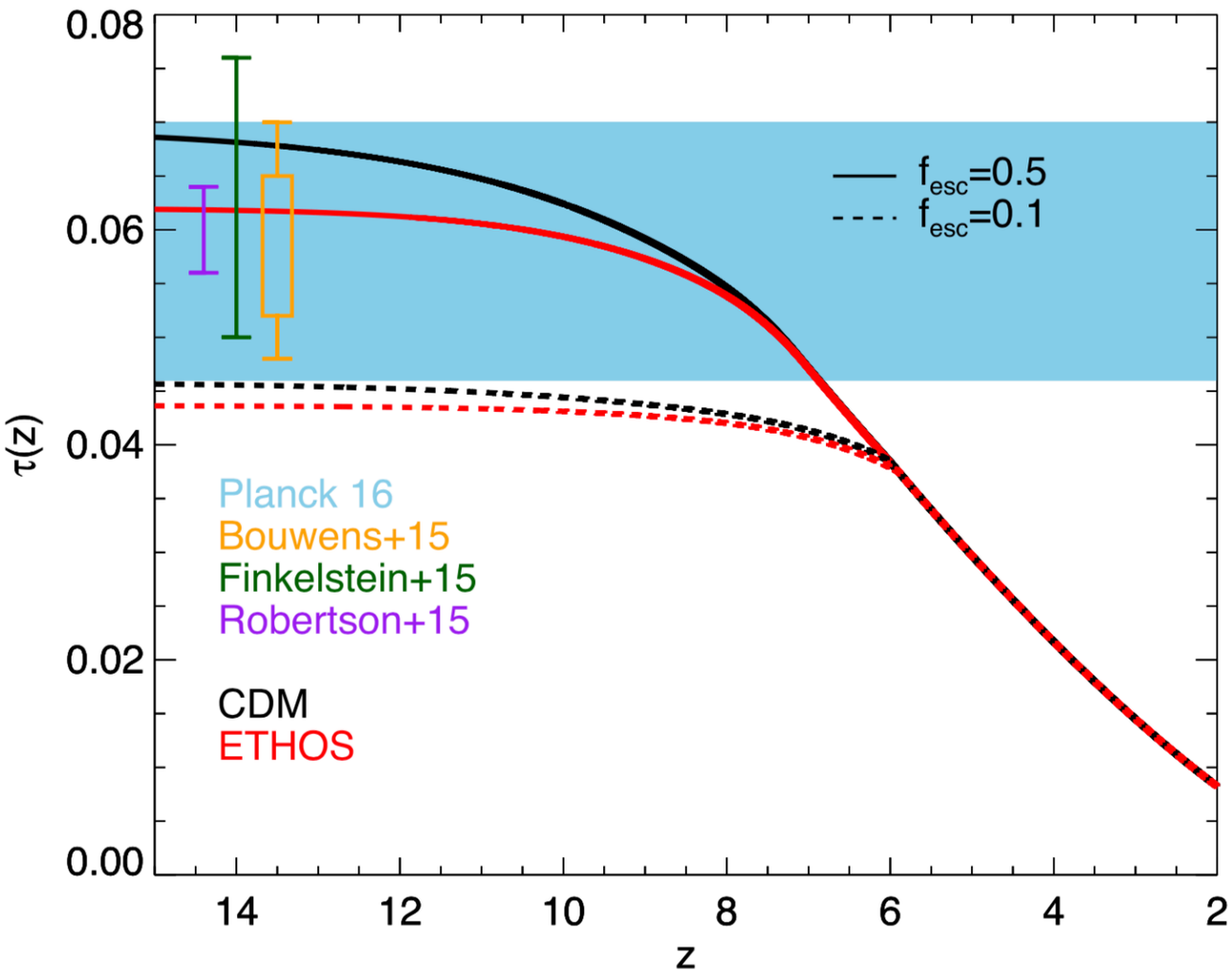

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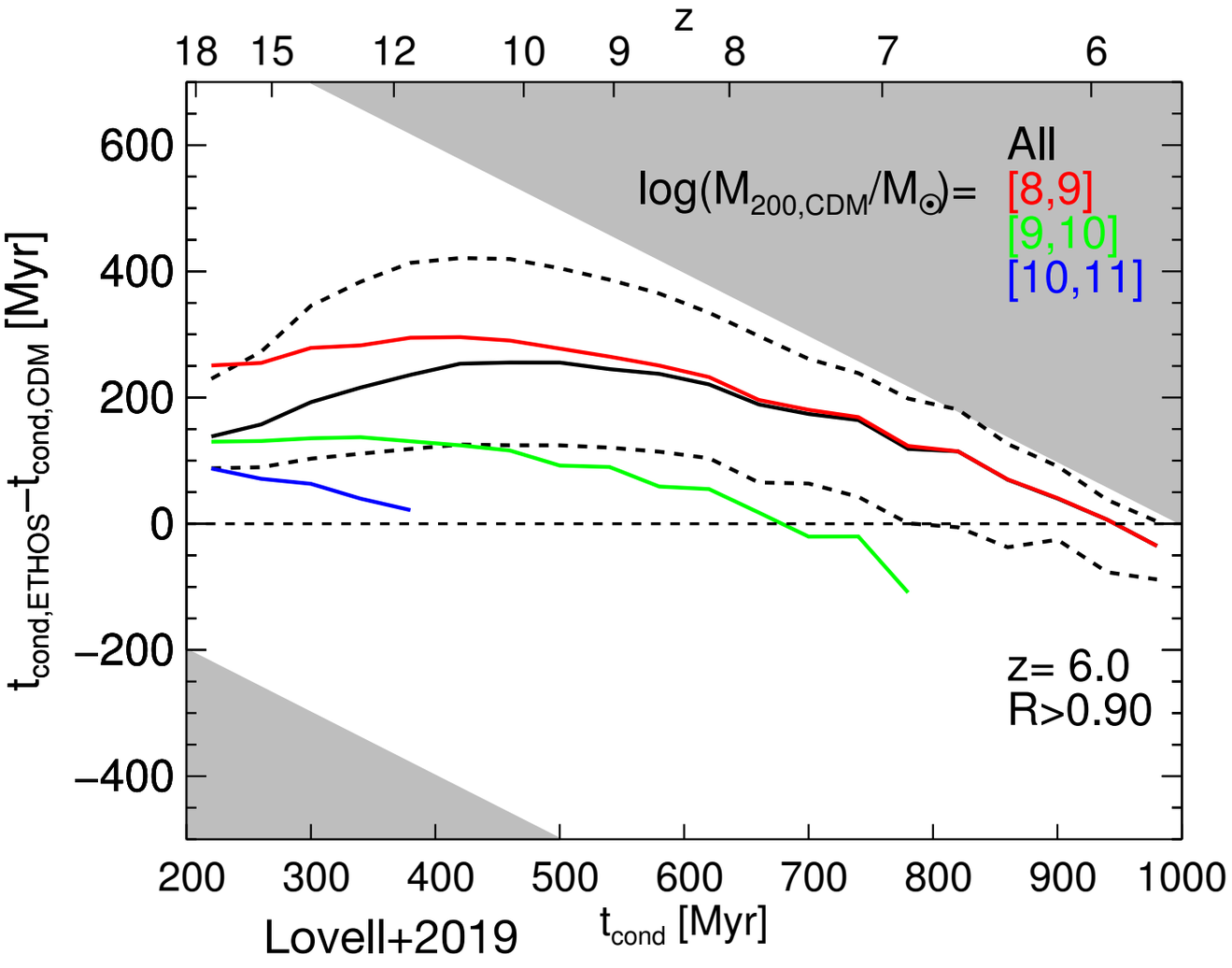
ETHOS vs. CDM — change in condensation time [t(M=$10^8 M_{sun}$)] & oldest stellar populations



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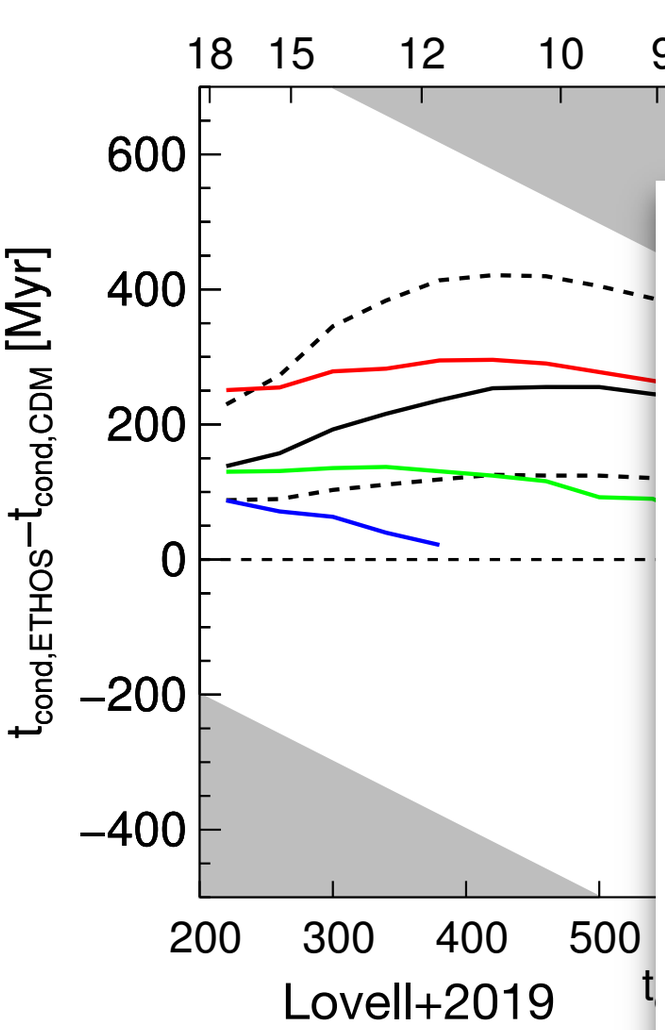

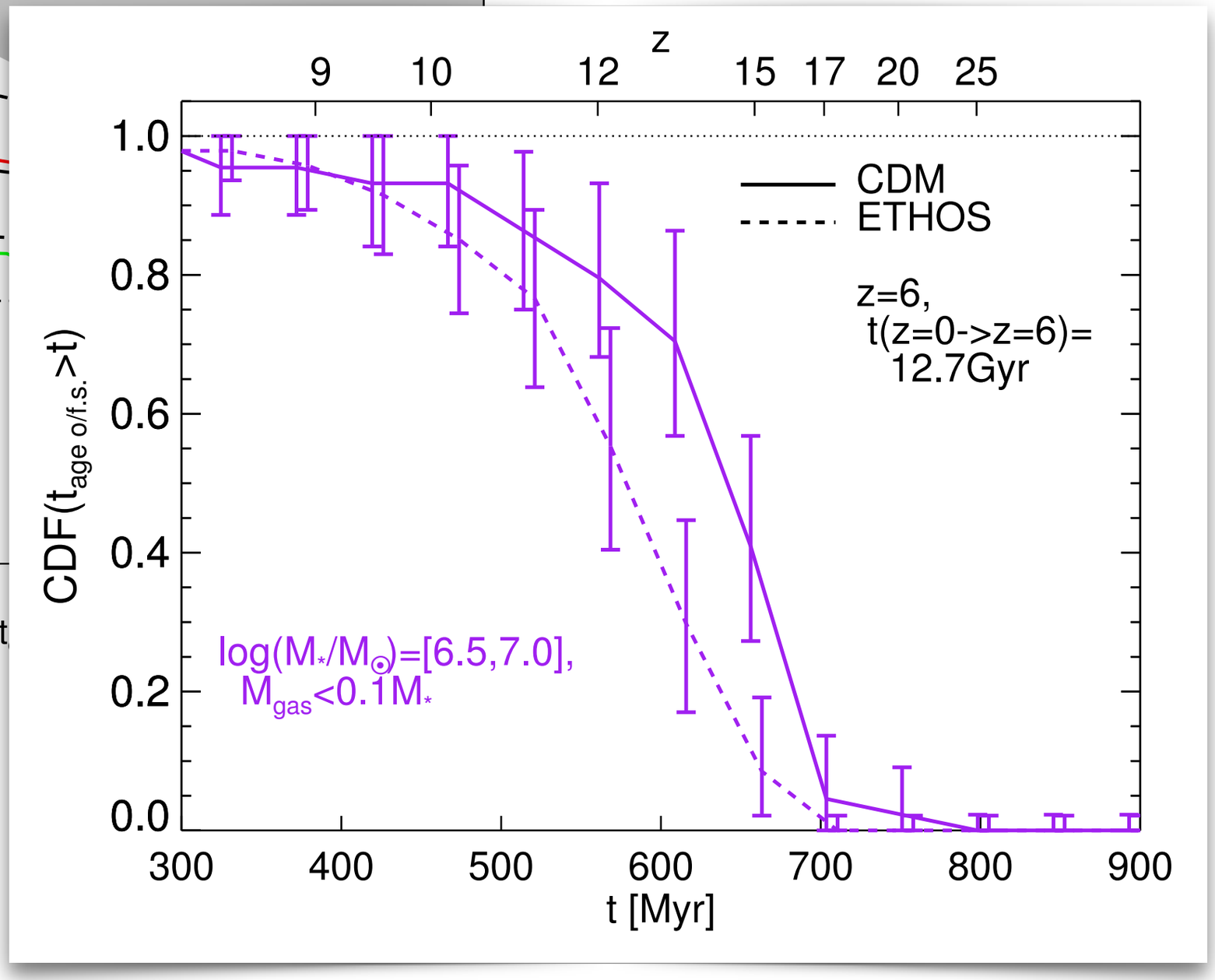

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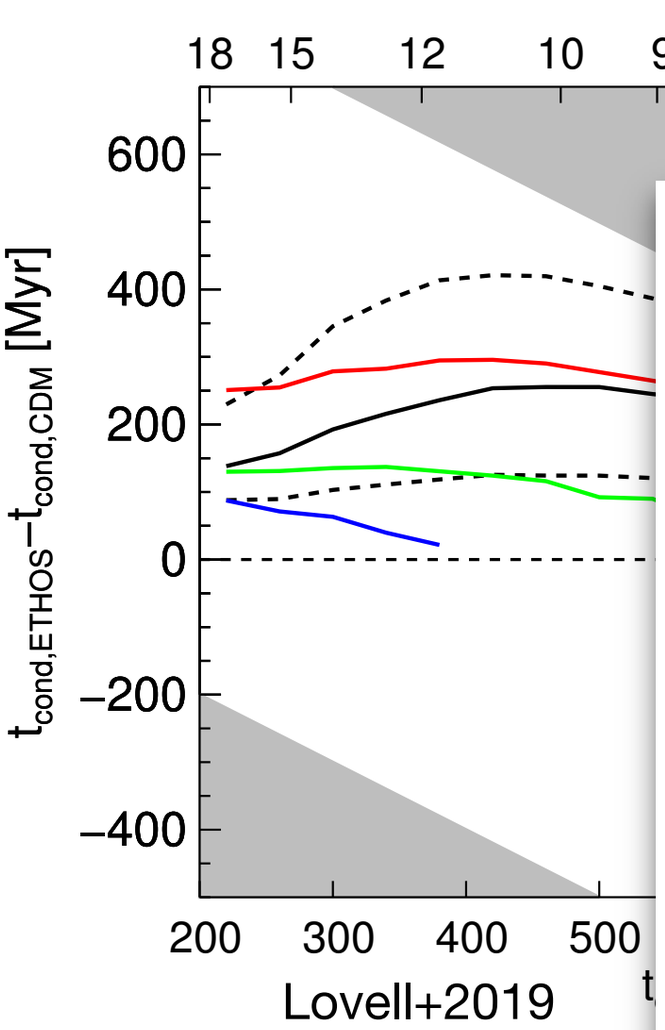

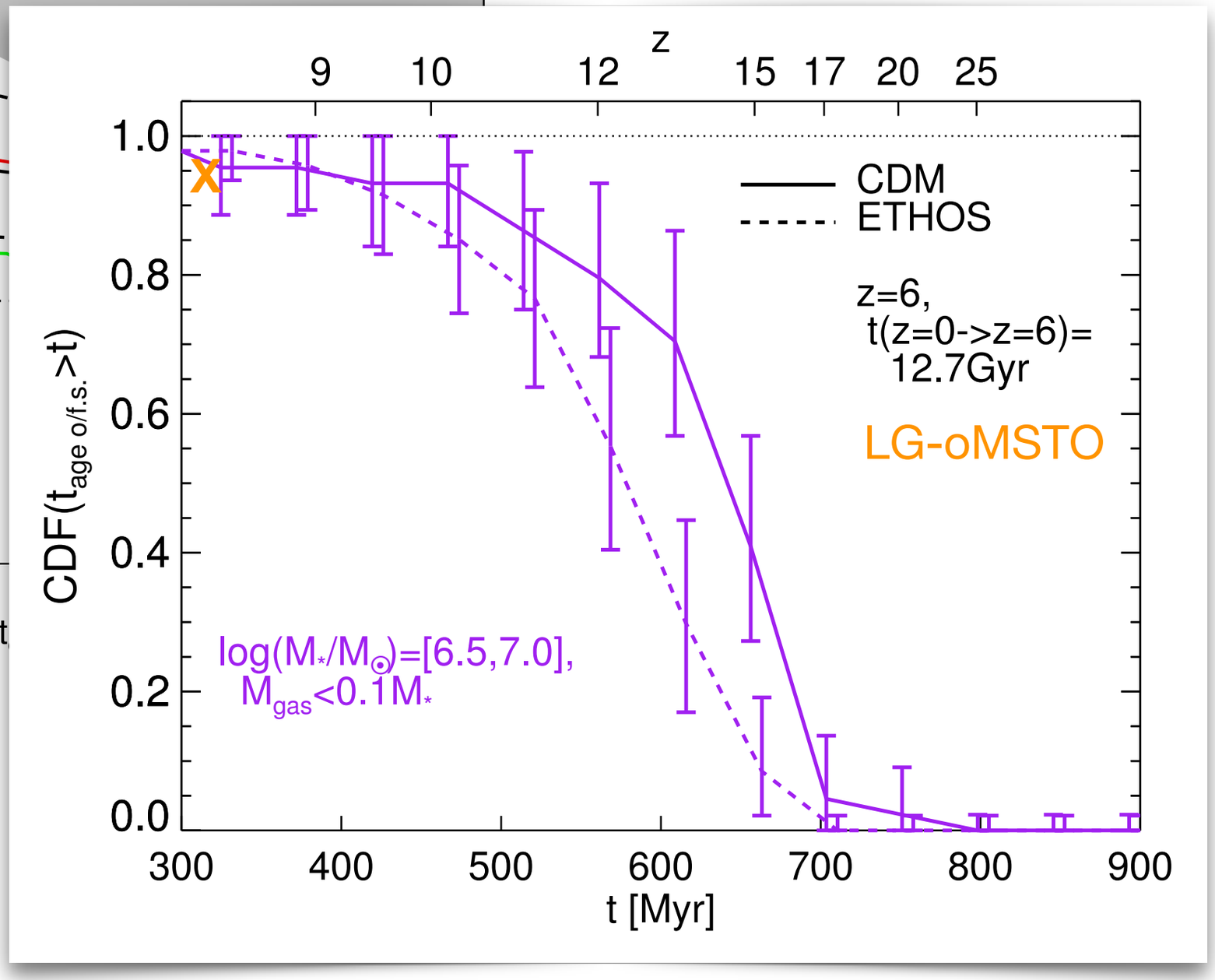

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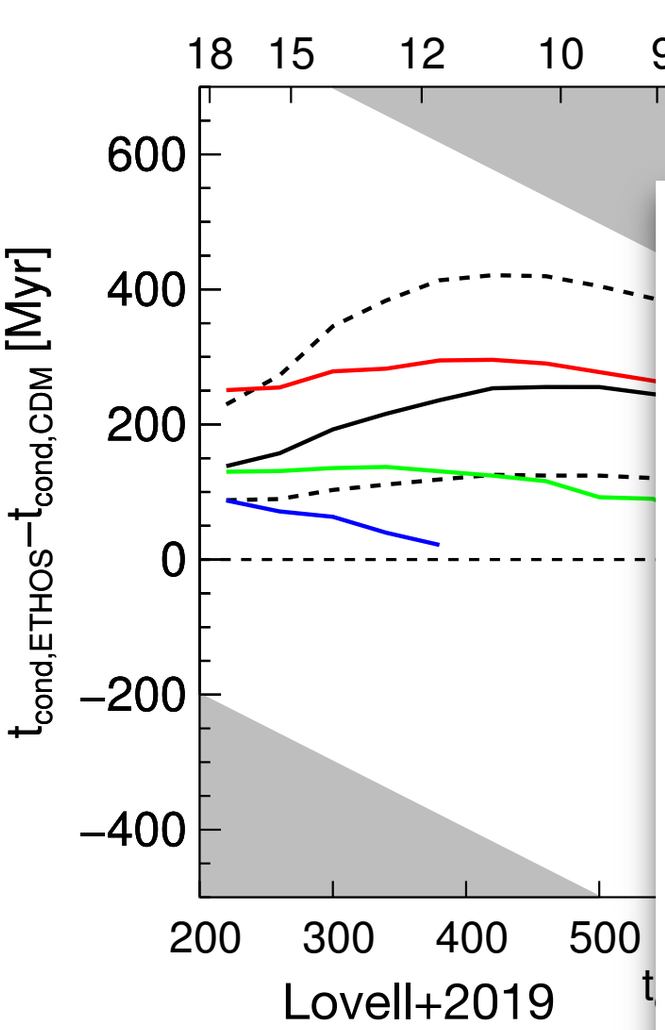

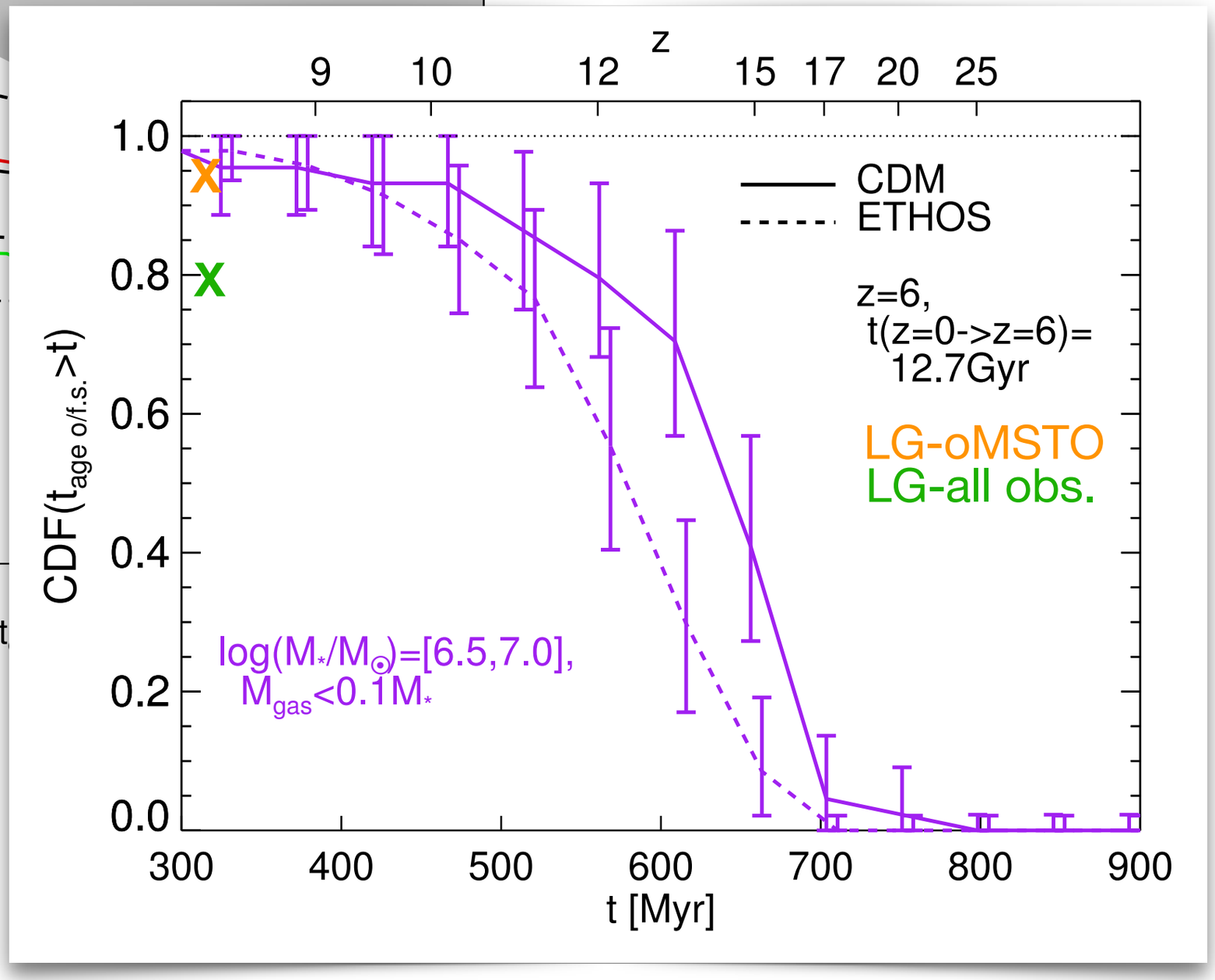

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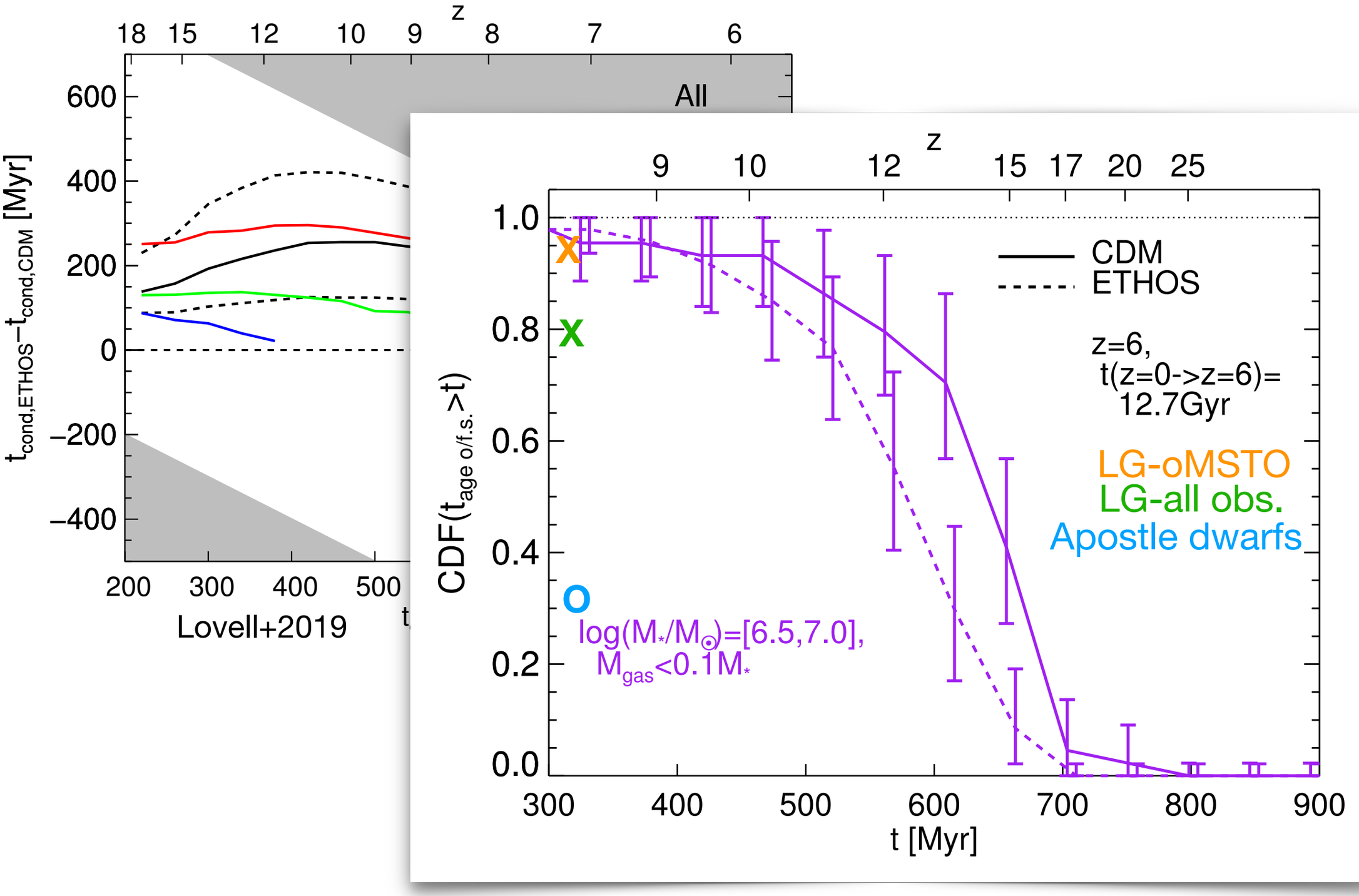

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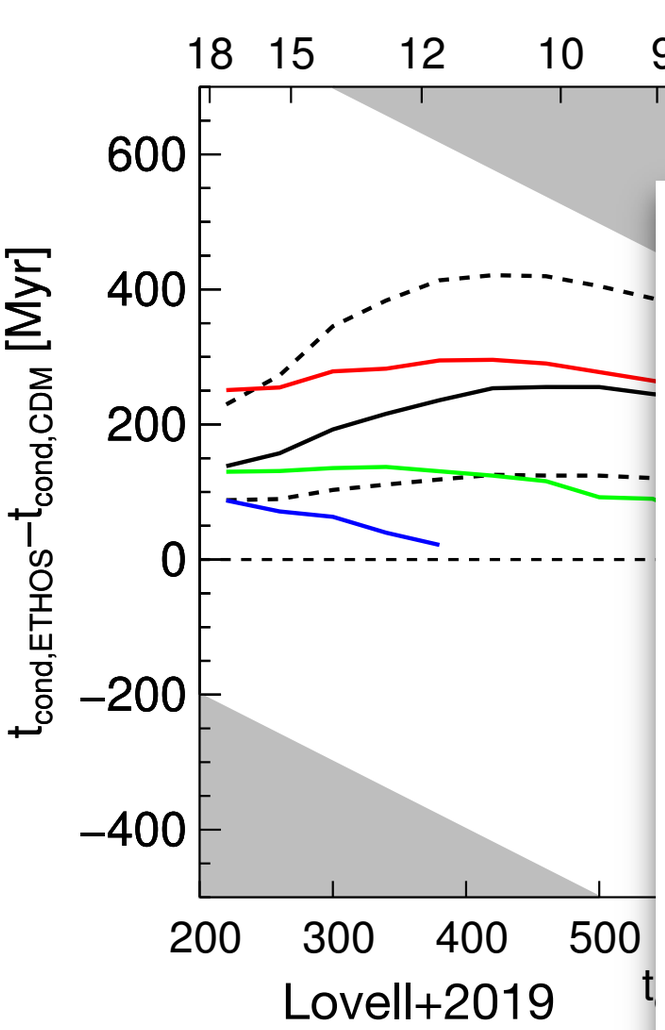

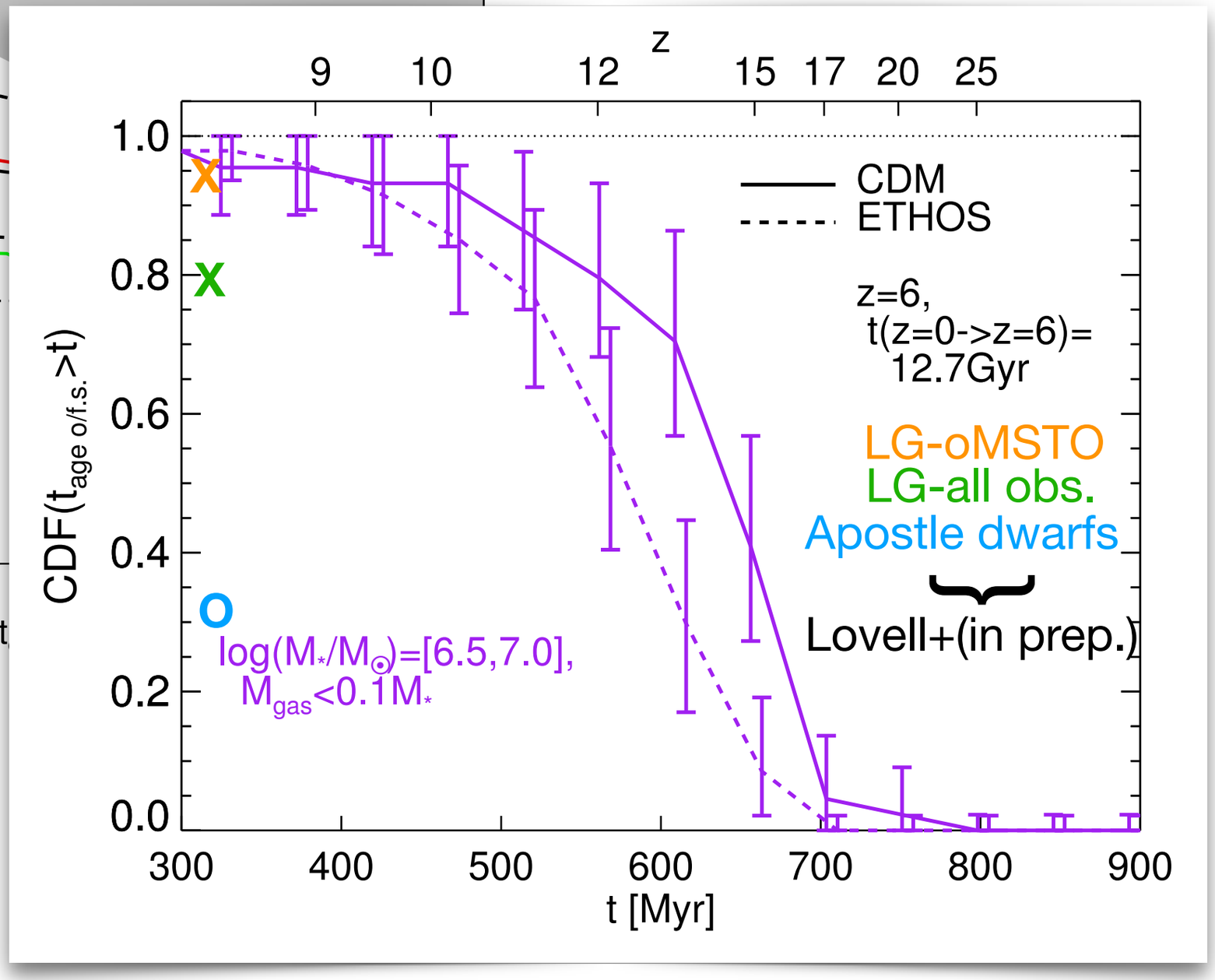

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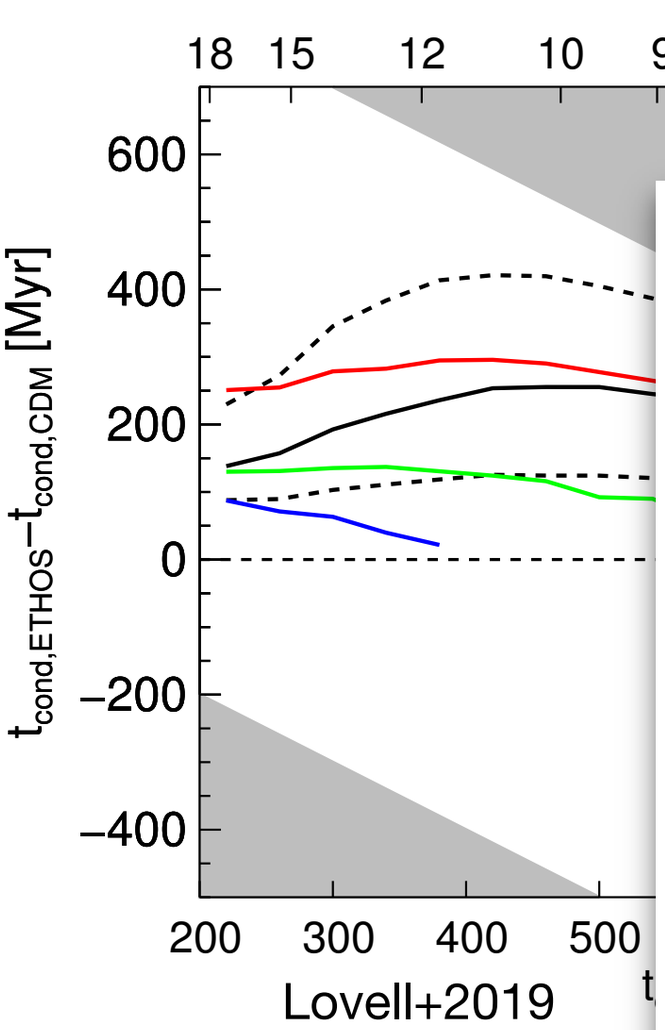

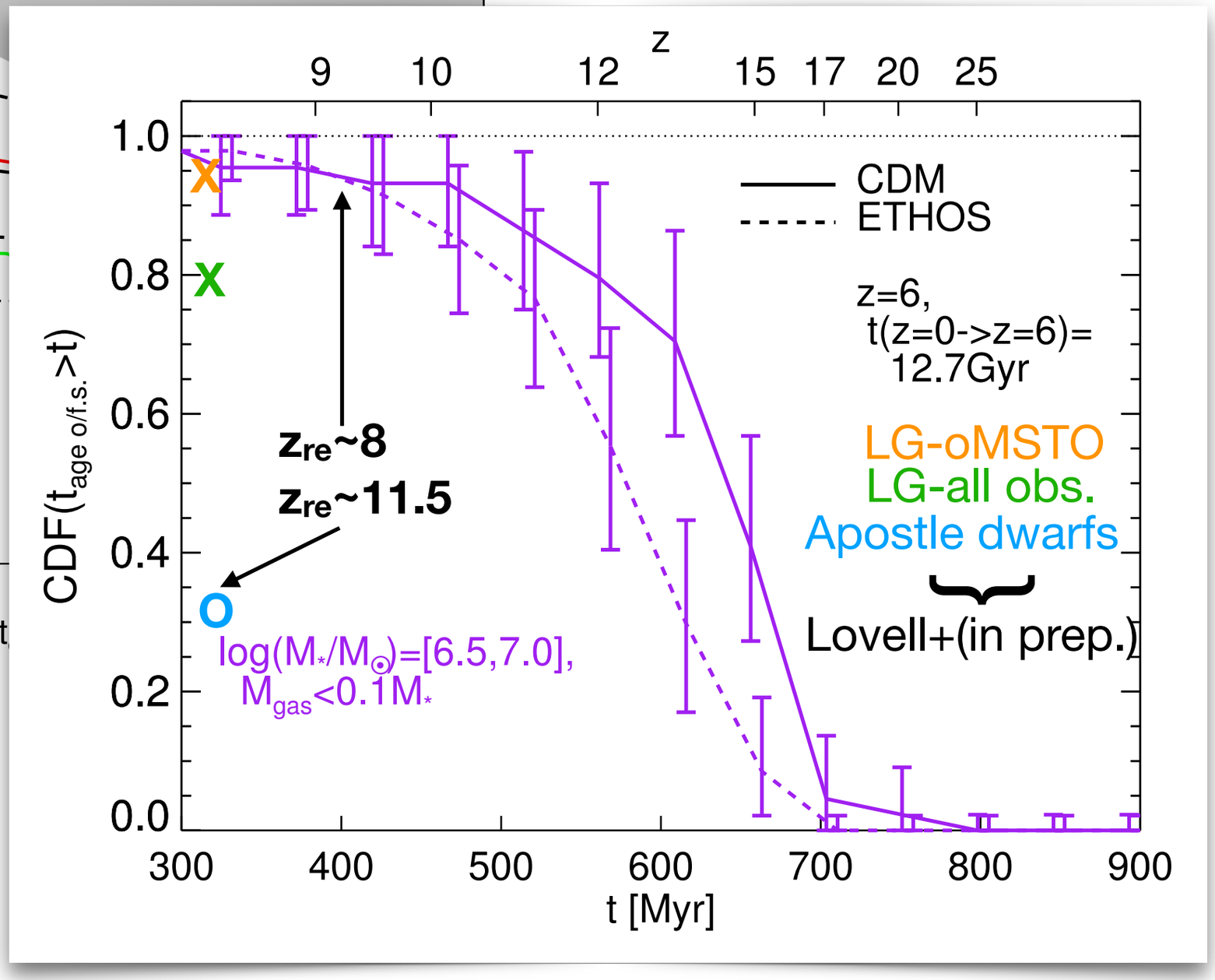

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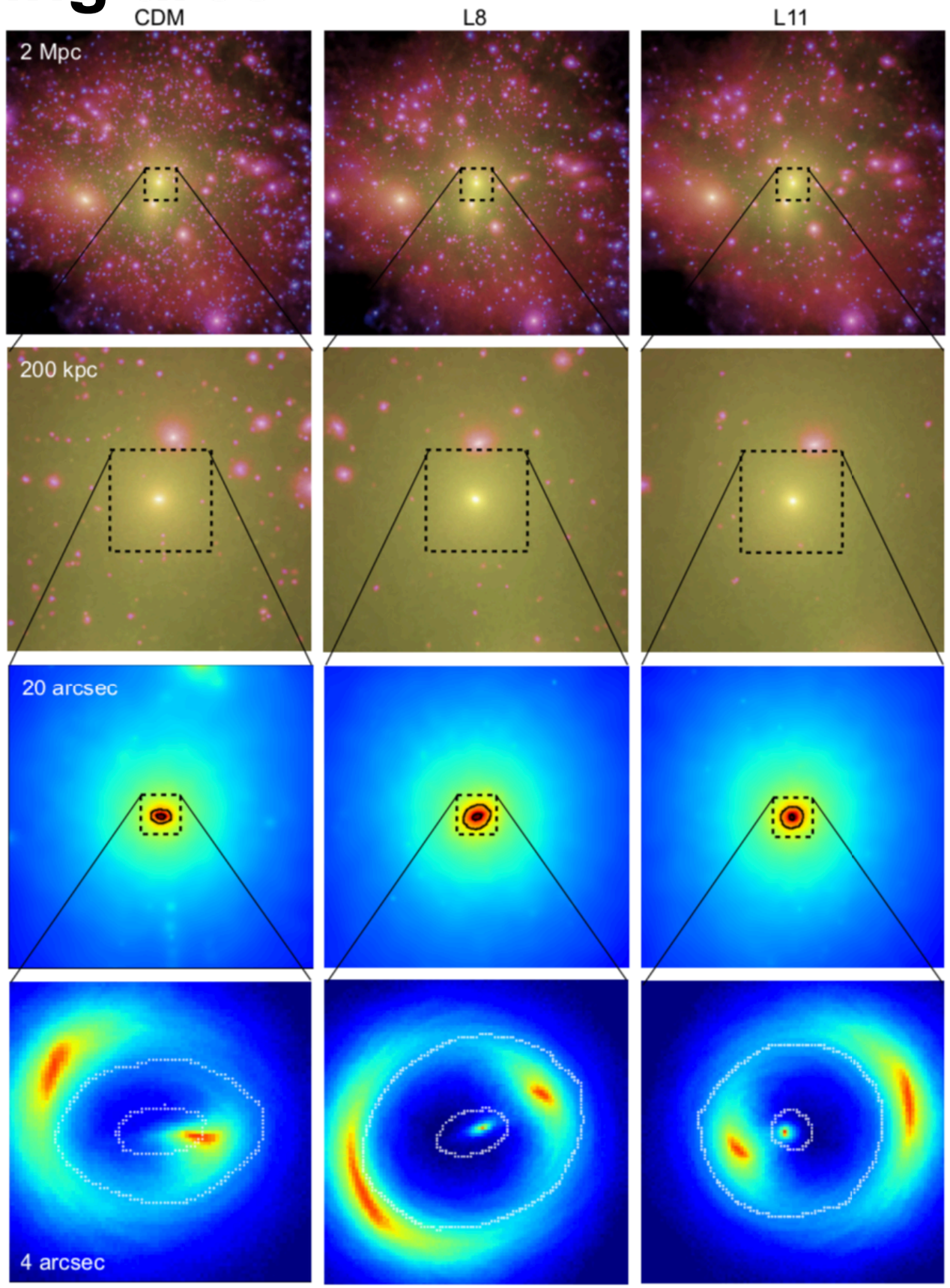
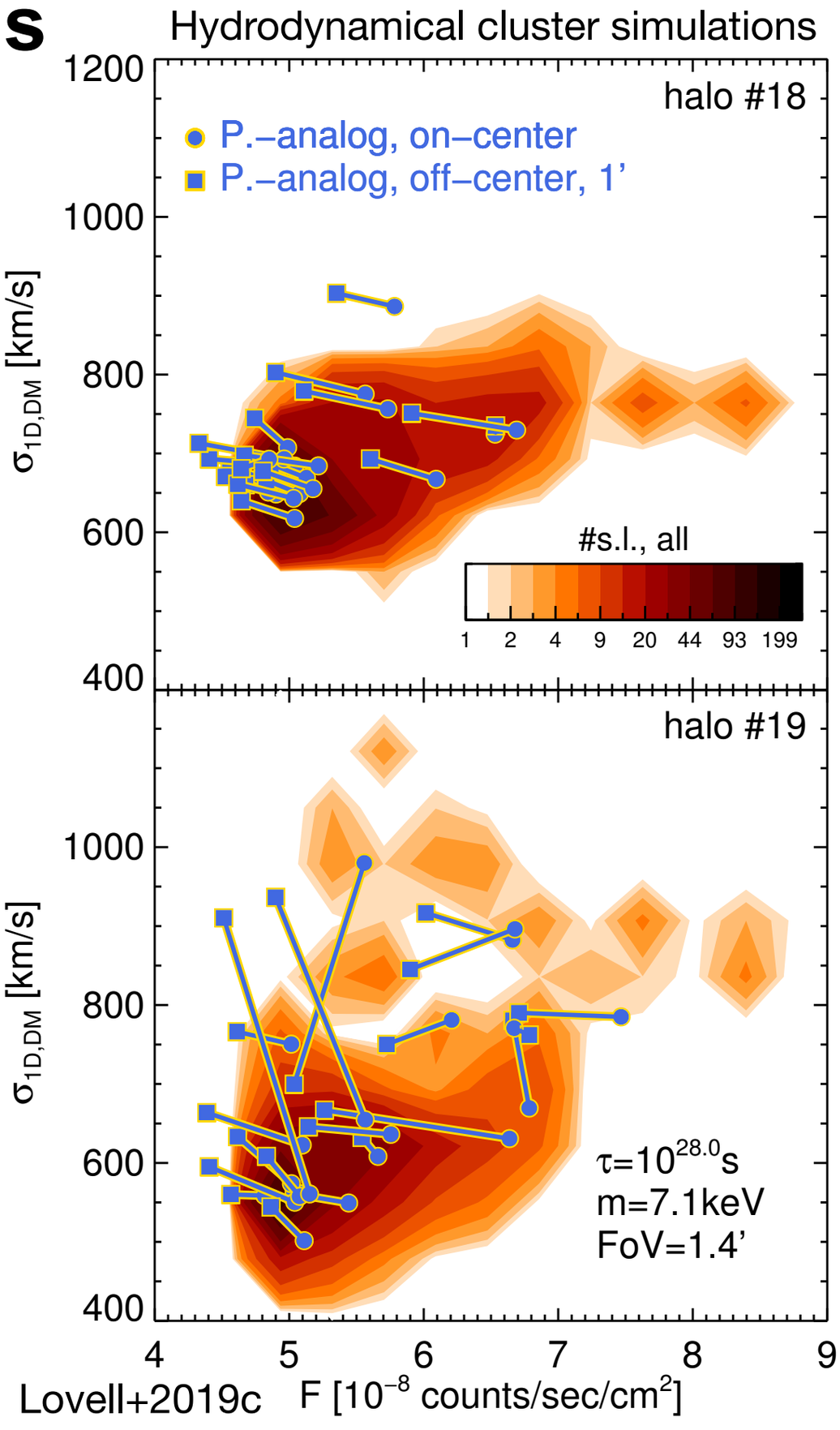
Aside: Lensing arcs



Despali, MRL, Vegetti, Crain, Oppenheimer 2019

Aside: DM detection in Perseus with XRISM

- XRISM X-ray observatory, scheduled to launch January 2022
- If 3.55keV line is DM, predict XRISM will detect a line with
- Flux ~5x10^{-8} counts/sec/cm2, and:
- **Velocity dispersion ~600km/s**
- Perseus details:
  DOI: 10.3847/2041-8213/ab13ac
- More X-ray predictions:
  DOI: 10.1093/mnras/stz691



Conclusions

- Suppresses DM mass, but gas mass enhanced
- SFR enhanced at high redshift with cutoff
- Consistent with high redshift observables
- Delay correlates inversely with galaxy mass
- ~100Myr delay possible in first star formation time, BUT:
- Need better reionisation, cooling, and escape fraction models to discern the nature of the dark matter. Plus more precise observations