

LYRA: Probing the high-resolution regime of cosmological zoom-in simulations

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Building Galaxies from Scratch - Vienna

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NATURE OF DARK MATTER?

Dark matter assembles in Halos

Characteristic shape for the density profile

Navarro, Frenk & White (1996b, 1997)



Image Credit: Sawala et al (2015). - The APOSTLE simulations



Why Dwarf Galaxies?

- Stellar masses $M_* \lesssim 10^9 M_{\odot}$
- Relics of the first galaxies
- Mass scale sensitive to the nature of Dark Matter

• Baryonic feedback becomes relevant at these masses

What can we learn from simulations?

What can we learn from simulations?

100 pc

Gutcke et al. (2022)



High resolution galaxy formation model

Gutcke et al. (2022)









Individual supernova blast waves followed

Resolved multi-phase ISM down to 10K

Individual stars sampled from the IMF down to $4 M_{\odot}$

Cosmological Zoom ICs



| Mass Resolution | LYRA (Gutcke + 2022) | EDGE (Agertz + 2020) | FIRE (Wheeler + 2019) | APOSTLE (L1) (Sawala + 2015) |
|--------------------|--------------------------------|----------------------------------|--------------------------|---------------------------------|
| Dark Matter | 80 M _☉ | 120 <i>M</i> _☉ | $\sim 150M_{\odot}$ | $\sim 5 \times 10^4 M_{\odot}$ |
| Baryons | 4 <i>M</i> _☉ | 20 M _☉ | $30M_{\odot}$ | $\sim 10^4 M_{\odot}$ |
| | | | | |



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Different star formation histories

- Halo A forms stars after reionization (Rejuvenated)
- Halo E is a reionization relic



Density profiles at redshift 0





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z = 0



z = 0



z = 0



What about the baryonic contents?



Metallicity

Within the expectations for dwarf galaxies in the Local Group





Metallicity



Summary

LYRA galaxies do not show signs of a dark matter core, but baryons prove to have a role in shaping the dark matter profiles of dwarf galaxies The growth history of these dwarf galaxies determines their overall metallicities and stellar properties



Stay tuned for more results from the LYRA simulations!

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