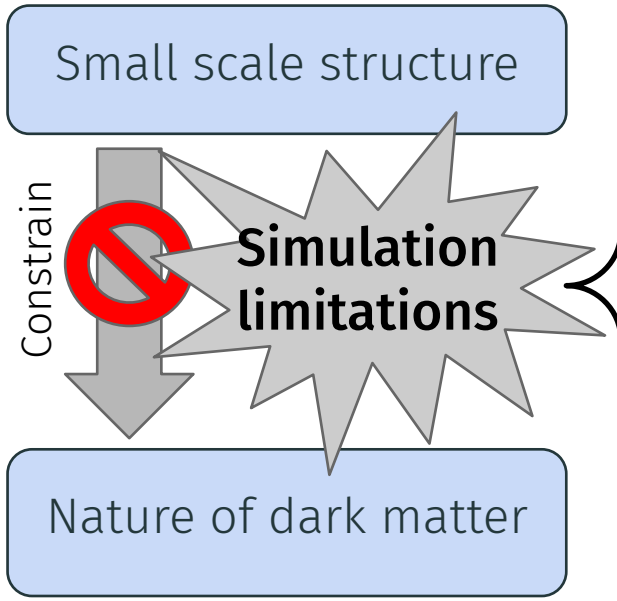
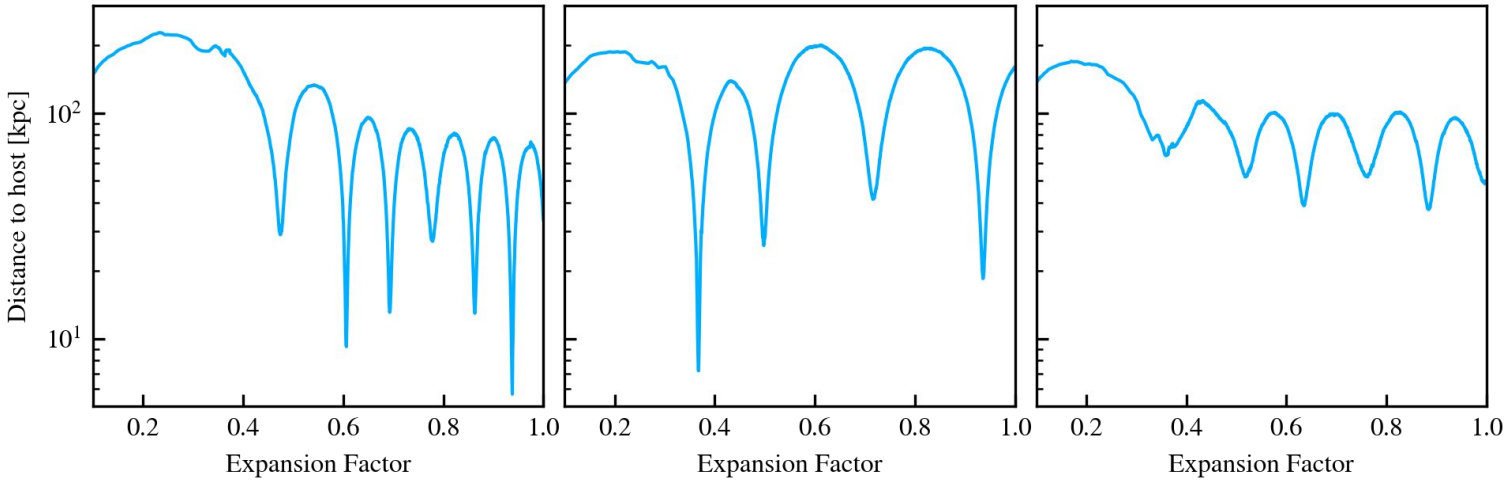
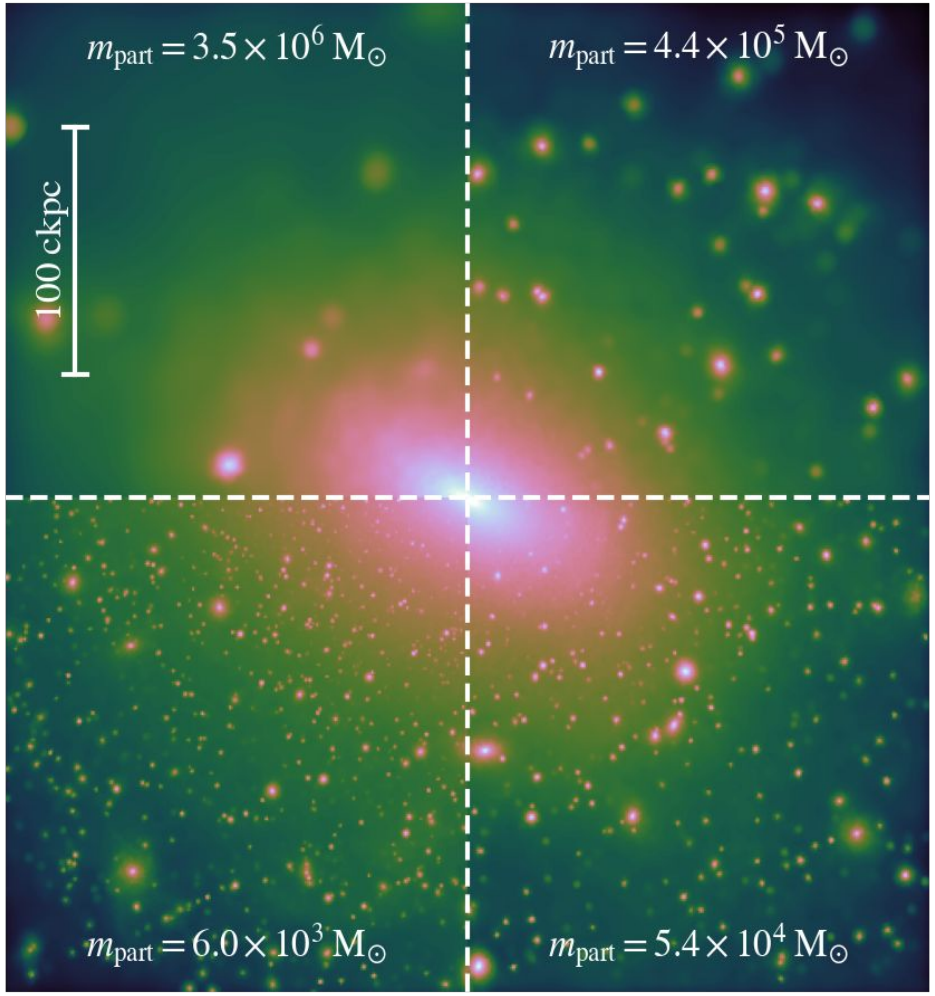
Addressing prediction limitations in small scale structures.

Victor Forouhar Moreno, Carlos Frenk, Shaun Cole & Alejandro Benitez-Llambay.



Problem	Solution (?)
Resolution	Tidal tracks, "orphans"
Storage	Orbit Interpolation





PICS

Planetary nebulae In Cosmological Simulations

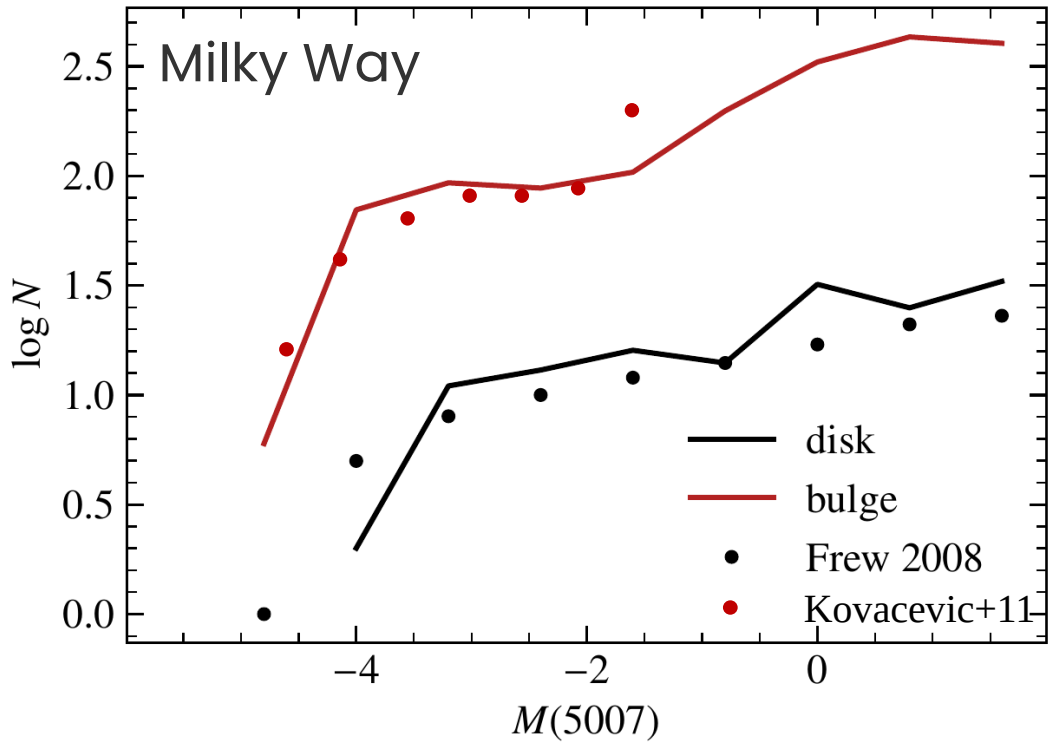
Single Stellar Population

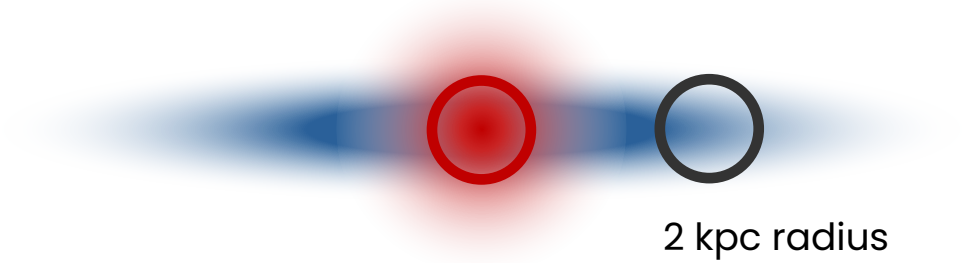
- Total mass
- Age
- Metallicity

→

Planetary Nebula Population

- Stellar mass
- [OIII] λ5007 intensity





Lucas M. Valenzuela
Universitäts-Sternwarte München

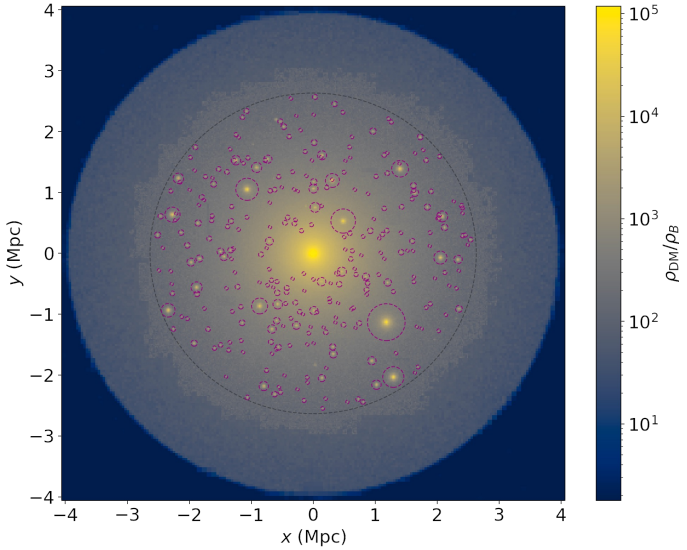
→ **Full reproduction of observed PNe properties**

The public codes ASOHF and vortex for the post-processing of cosmological simulations

David Vallés-Pérez, Susana Planelles & Vicent Quilis
Universitat de València

ASOHF: *a lightweight DM halo + galaxy finder*

- Based on the SO paradigm
- Physically-motivated definition of substructures
- Identifies galaxies as their own independent objects
- OMP parallelism + domain decomposition (either sequential or concurrent)
- Low memory footprint, good scaling, no additional libraries required



vortex: *decompositions of multi-resolution velocity fields*

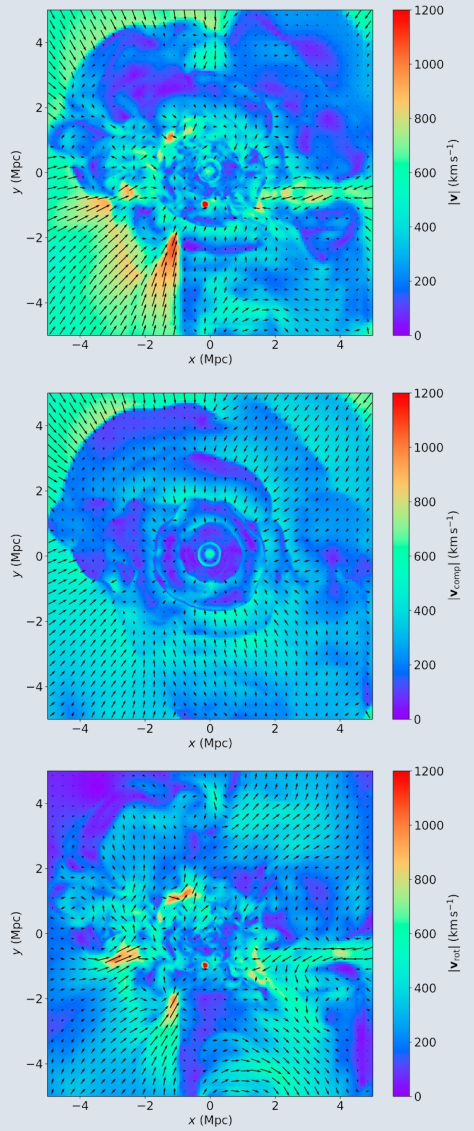
- Helmholtz-Hodge decomposition

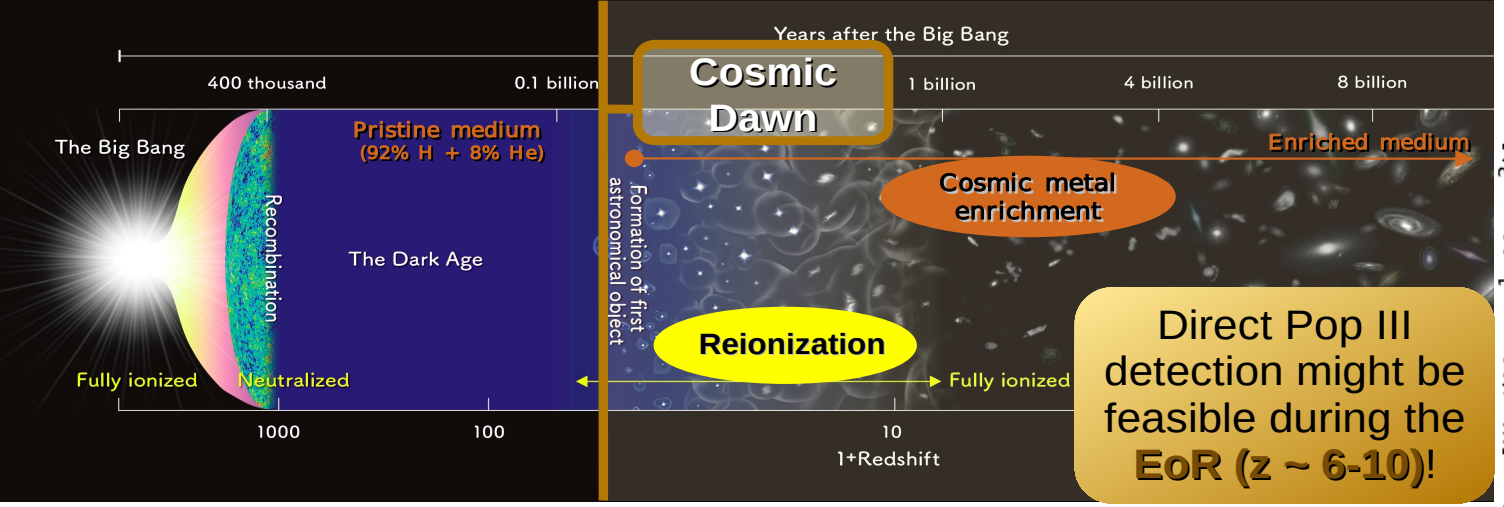
$$\vec{v} = \underbrace{\vec{v}_{\rm comp}}_{\nabla\times\vec{v}_{\rm comp}=0} + \underbrace{\vec{v}_{\rm sol}}_{\nabla\cdot\vec{v}_{\rm sol}=0} + \underbrace{\vec{v}_{\rm harm}}_{\text{Harmonic term}}$$

- Reynolds decomposition

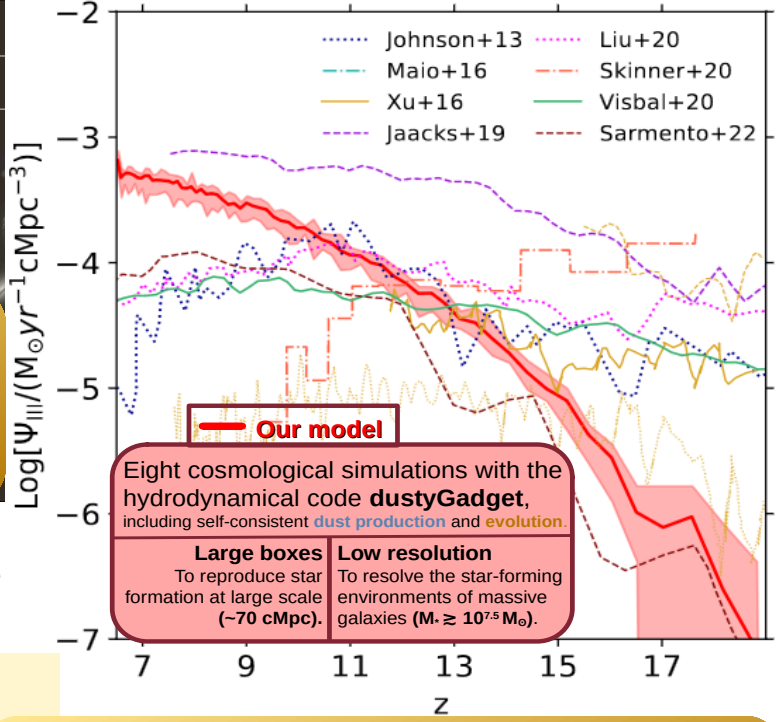
$$\vec{v}(\vec{x}) = \langle\vec{v}\rangle_{L(\vec{x})}(\vec{x}) + \delta\vec{v}(\vec{x})$$

- Originally for block-based AMR, version for particle-based/moving-mesh simulations to be publicly-released soon!



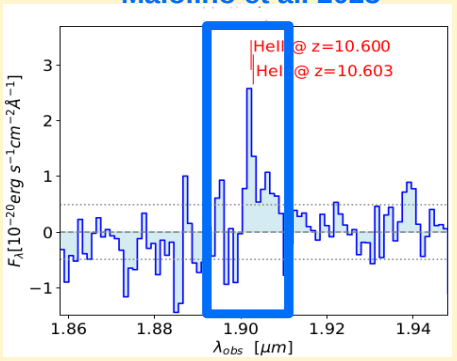


Direct Pop III detection might be feasible during the **EoR (z ~ 6-10)**!

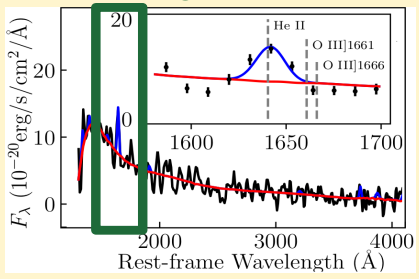


Many models predicting a **late Pop III star formation**, due to inhomogeneous metal enrichment, even in the external regions of massive evolved galaxies.

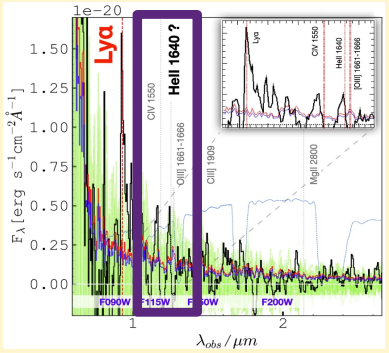
GN-z11 (z~10.6)
Maiolino et al. 2023



RXJ2129-z8HeII (z~8)
Wang et al. 2022



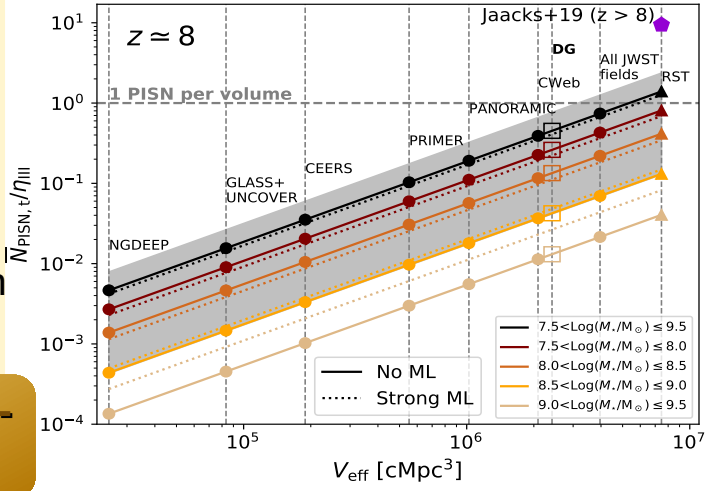
LAP1 (z~6.6)
Vanzella et al. 2023



Looking for spectral features identifying active Pop IIIs in high-z galaxies, e.g. **HeII line at 1640 Å**.

Already a few candidates, but why are we not seeing more?
→ **Observational biases**:

- Sensitivity
- FoV
- Dust absorption
- Other sources



Very **bright**, but **rare**!

+ Indirect probes, e.g. **Pair-Instability Supernovae**.

"A needle in a haystack? Catching Pop III stars in the Epoch of Reionization"

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