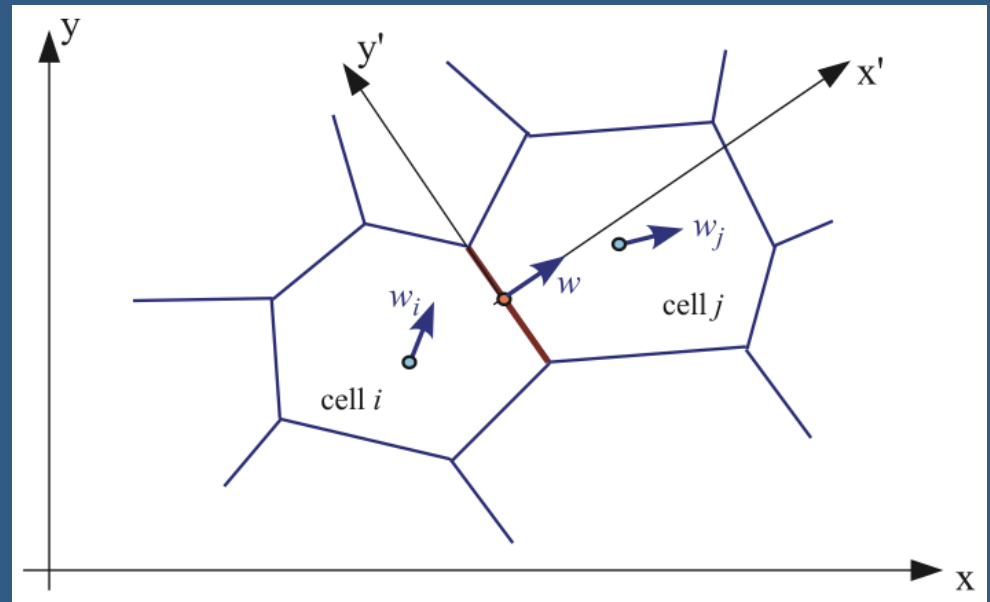
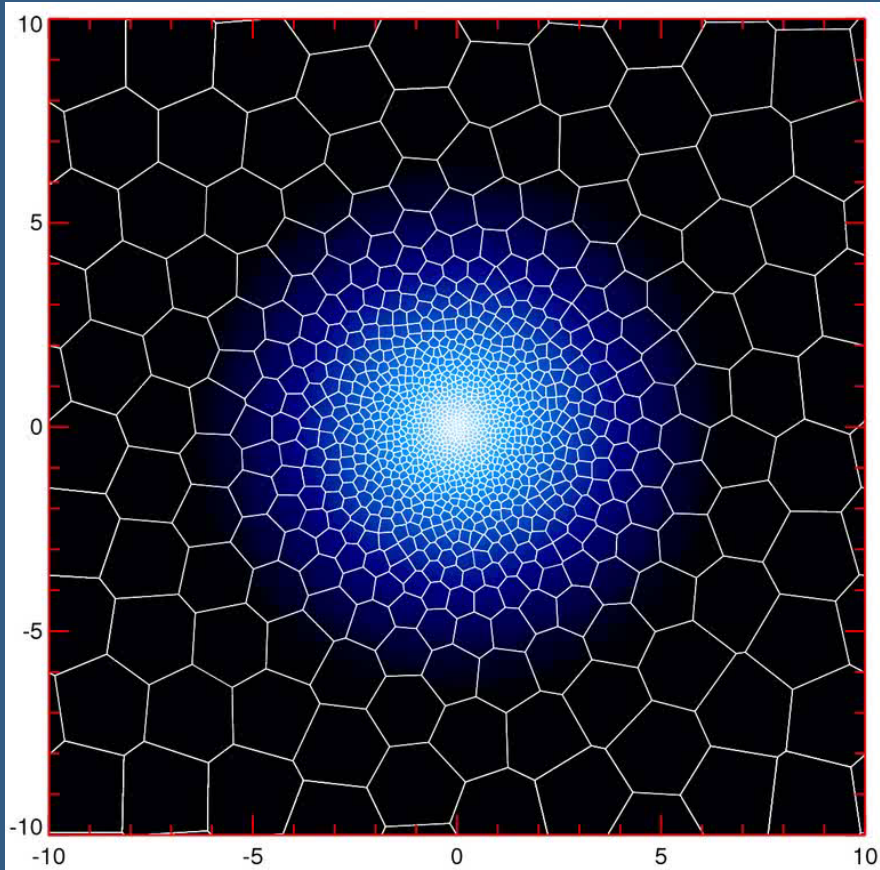


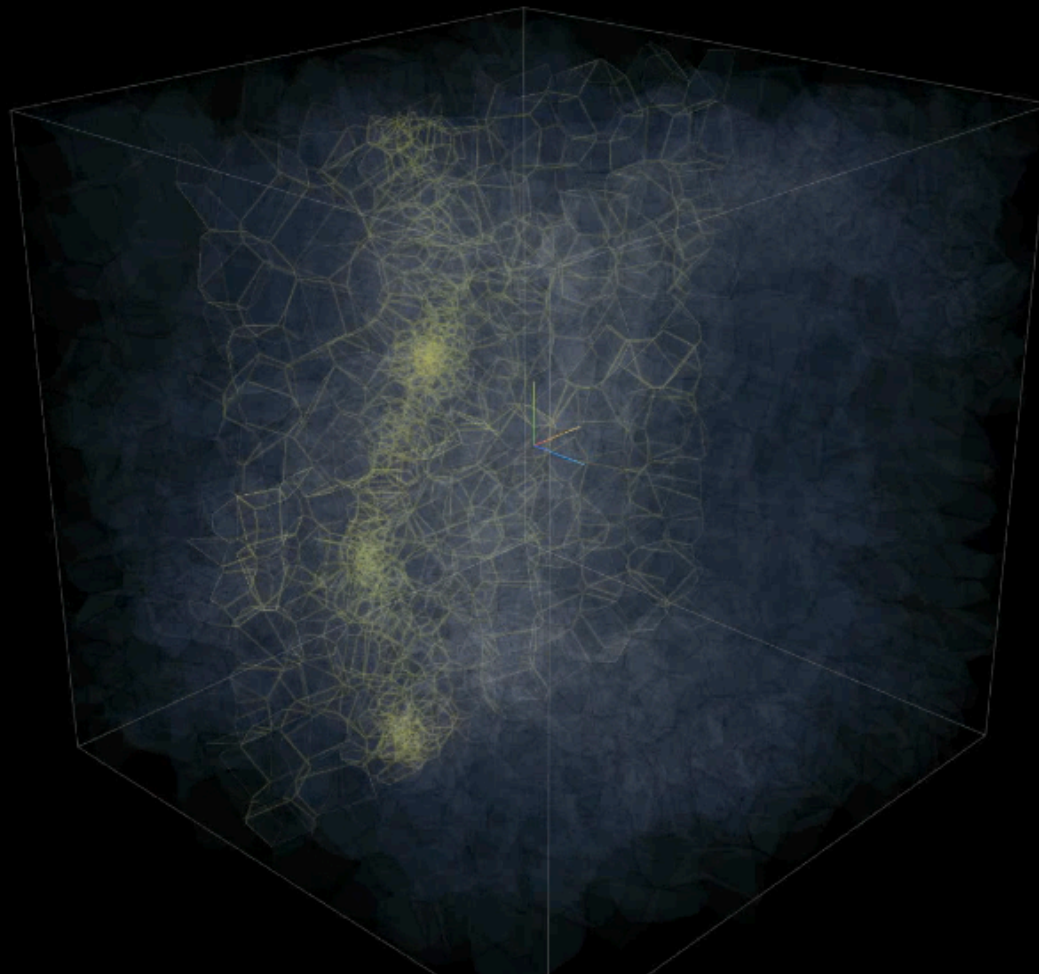
Quasi-Lagrangian hydro: a moving unstructured mesh with Arepo



Springel 2010

Quasi-Lagrangian hydro: a moving unstructured mesh with Arepo

Courtesy of
Dylan Nelson



Quasi-Lagrangian hydro: a moving unstructured mesh with Arepo

Community:

~50 people with code access, ~15 active users, ~10 active developers

Major activity hubs: HITS (Springel), ITC (Hernquist), MIT (Vogelsberger)

Existing capabilities:

- Gravity (Tree-PM)
- Hydrodynamics
- MHD
- Radiative cooling
- “Low-resolution” star-formation and feedback
- Stellar population evolution
- BHs and AGN feedback
- Tracer particles
- On-the-fly structure finder
- Shock finder

Physics under development:

- Constrained transport MHD
- Radiation-hydrodynamics
- “High-resolution” star-formation and feedback
- Cosmic rays
- Dust
- On-the-fly shock finder

Application: the Illustris simulation

Vogelsberger et al. 2014
Genel et al. 2014
Sijacki et al. 2015

- A $(106.5 \text{ Mpc})^3$ box run to $z=0$
- Baryonic resolution: $1.3 \times 10^6 M_{\text{sun}}$
- Resolution elements: 2×1820^3
- Gravitational spatial resolution: $0.7\text{-}1.4 \text{ ckpc}$
- Galaxy formation physics (SF, winds, AGN...)
- 20M cpu-hours = 8,192 cores X 3 months

The Illustris simulation

Vogelsberger et al. 2014
Genel et al. 2014
Sijacki et al. 2015

Public data release – April 2015 (Nelson et al. 2015)

ILLUSTRIS

ABOUT

PEOPLE

RESULTS

PRESS

IMAGES/VIDEOS

DATA ACCESS

THE EXPLORER

GALAXY OBSERVATORY



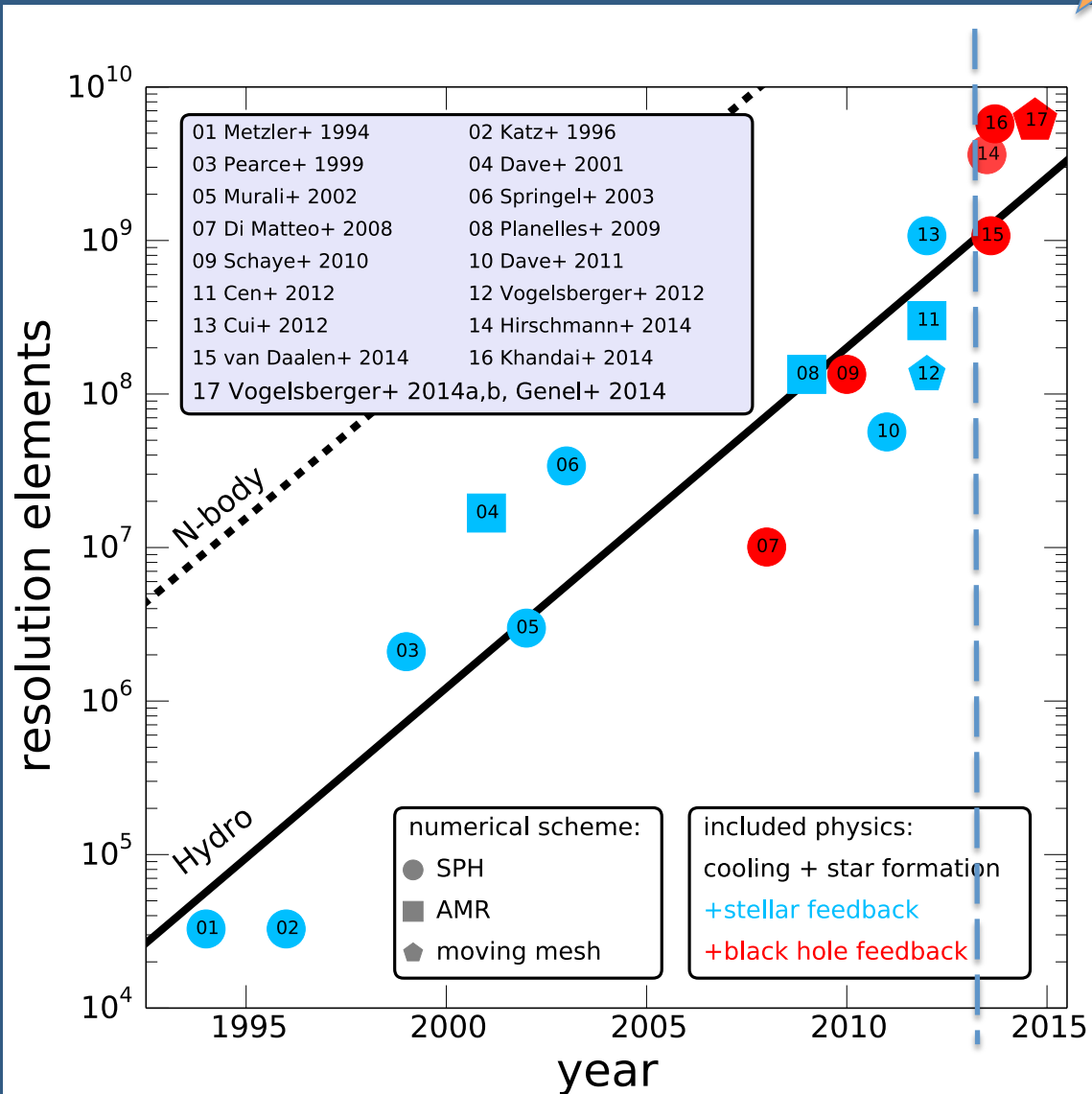
The screenshot shows the Illustris Explorer interface. The main view is a colorful galaxy simulation with a red and blue color map. On the left, there are navigation icons: a plus sign, a minus sign, a search icon, and an information icon. On the right, there is a 'Subhalo Search' panel with a table of search criteria and sliders.

Use?	Field	Units	Min	Max
<input type="checkbox"/>	Total Halo Mass	log (M_{sun})	11.6	12.4
<input type="checkbox"/>	Total Stellar Mass	log (M_{sun})	10.8	11.2
<input type="checkbox"/>	Total Gas Mass	log (M_{sun})	10.5	10.8
<input type="checkbox"/>	Parent Halo Virial Radius	kpc	200.0	300.0
<input type="checkbox"/>	U-band Luminosity	mag	-24.0	-16.0
<input type="checkbox"/>	idList		0,2,100-108	

Only search visible slice?

Search

'Uniform-box' cosmological simulations



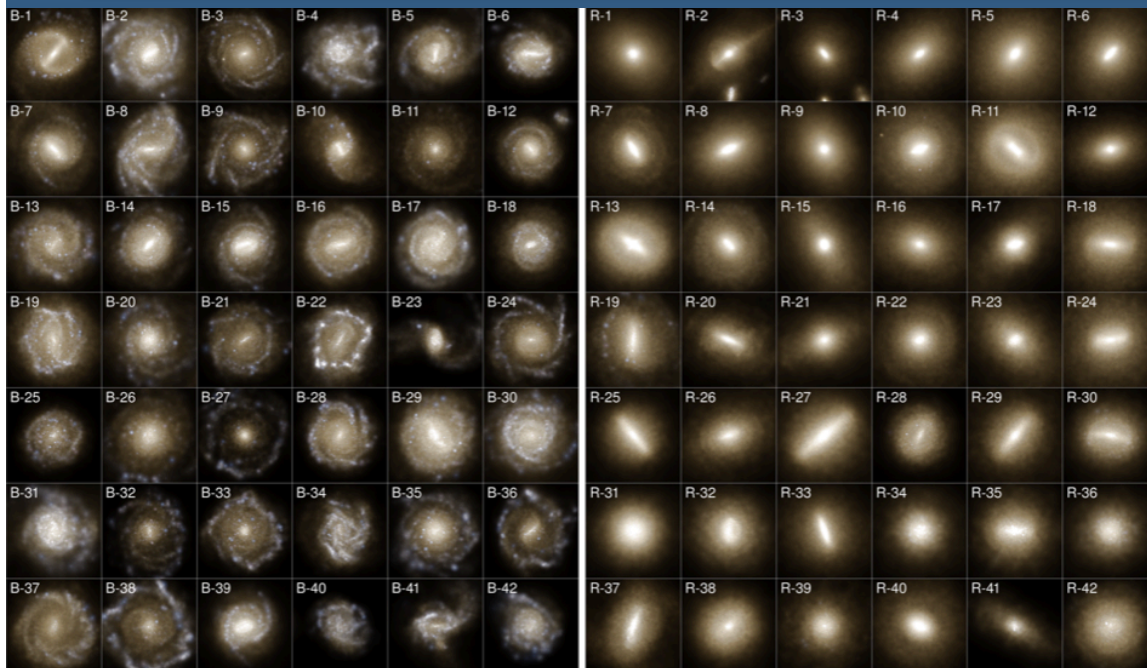
Illustris++
(in prep.)

Also ongoing: zoom-in runs

- MW-like halos
- Galaxy clusters

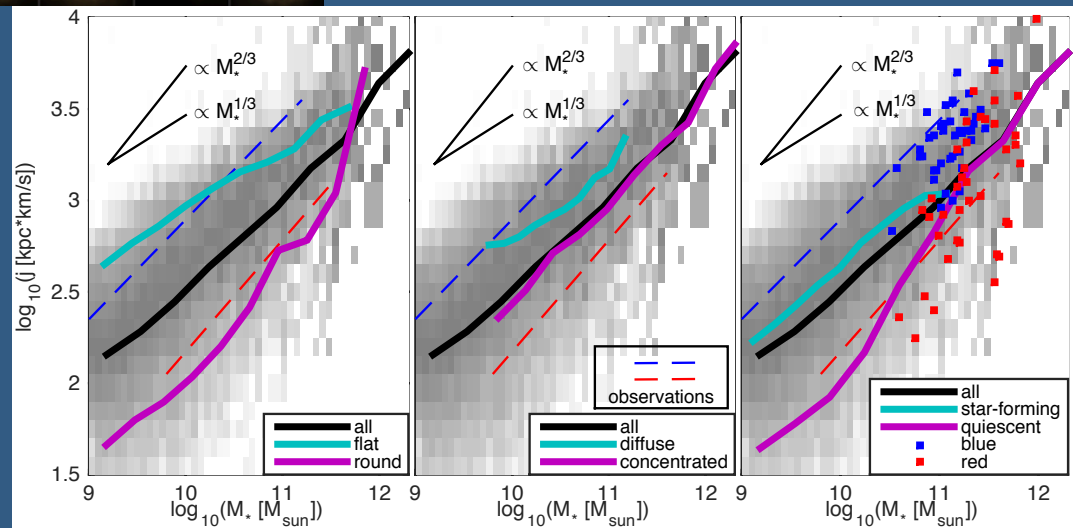
Genel et al. 2014

Galaxy bimodality & angular momentum



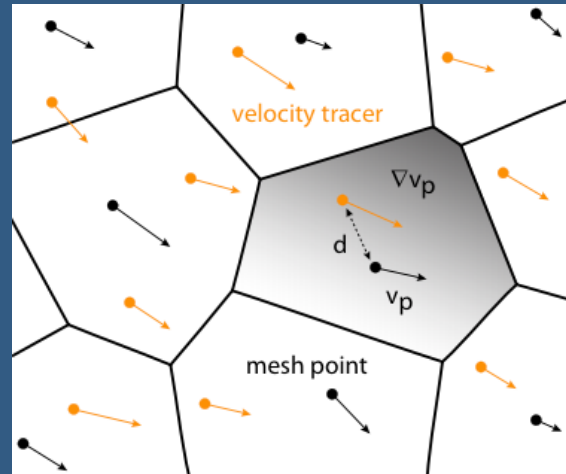
Genel et al. 2015

Vogelsberger, SG, et al. 2014

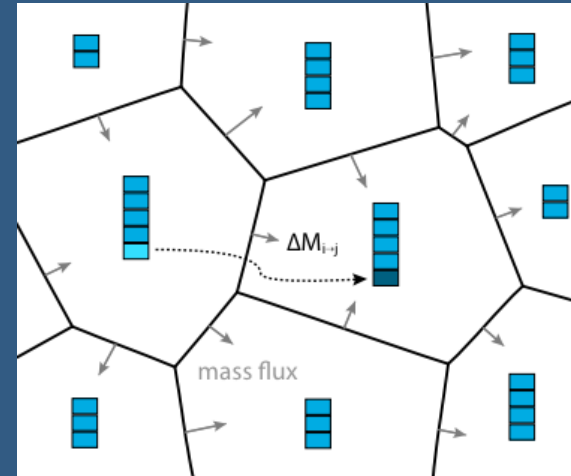


Tracer particles in Arepo

Velocity
Field
tracers



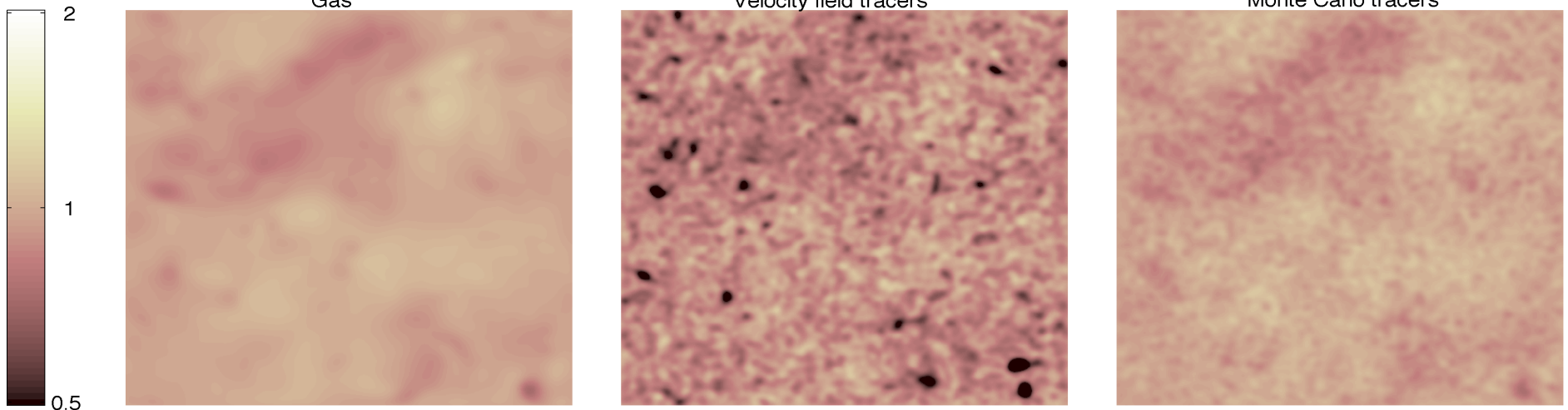
Monte
Carlo
tracers



Gas

Velocity field tracers

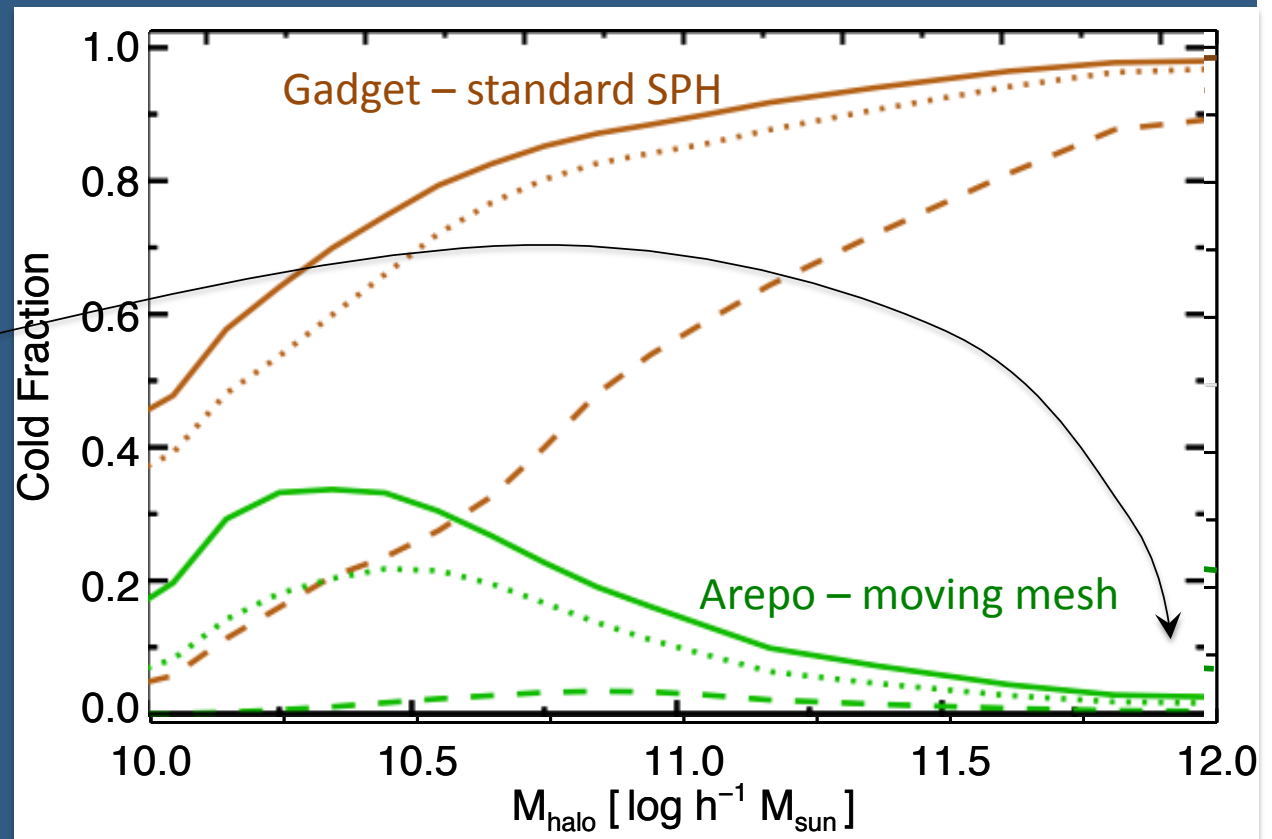
Monte Carlo tracers



Cold mode fraction of galaxy gas

'Smooth' gas accretion is hot-dominated everywhere at $10^{10} < M[M_{\odot}] < 10^{12}$

Cold fraction dropping to ≈ 0 at $M \approx 10^{12} M_{\odot}$



Halo gas structure @ $z=2$ – zoom-in simulations

