The SWIFT pipeline: from zero to ~~hero~~ halo

Swiftcon

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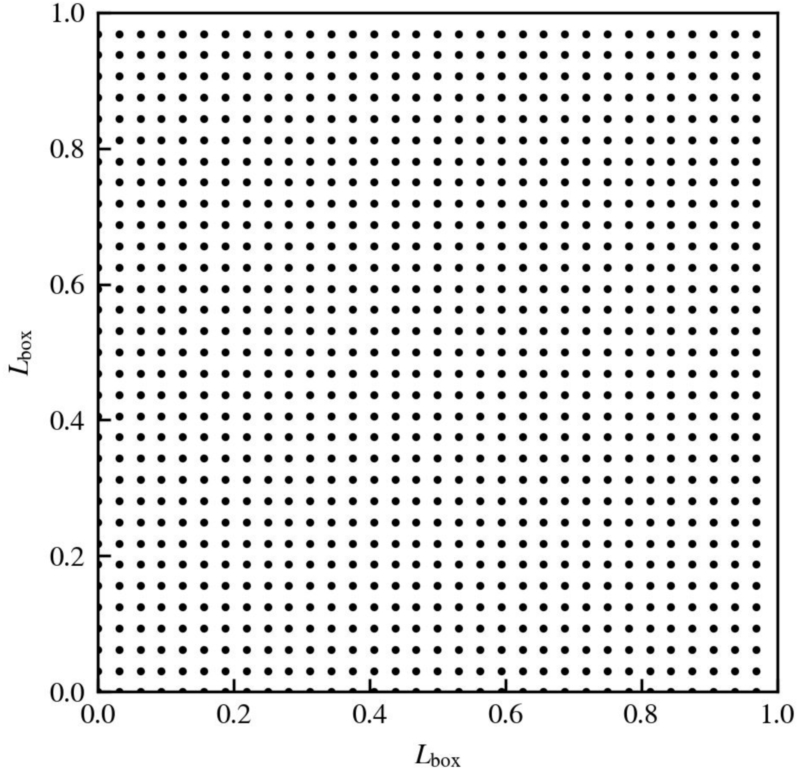
Overview

General Ideas	**Codes**
IC generation	*MONOFONIC*
Gravity integration	*SWIFT*
Halo finding	*HBT+*
Halo properties	*SOAP*

Initial conditions

1. Create a grid / glass (homogenous) particle distribution.



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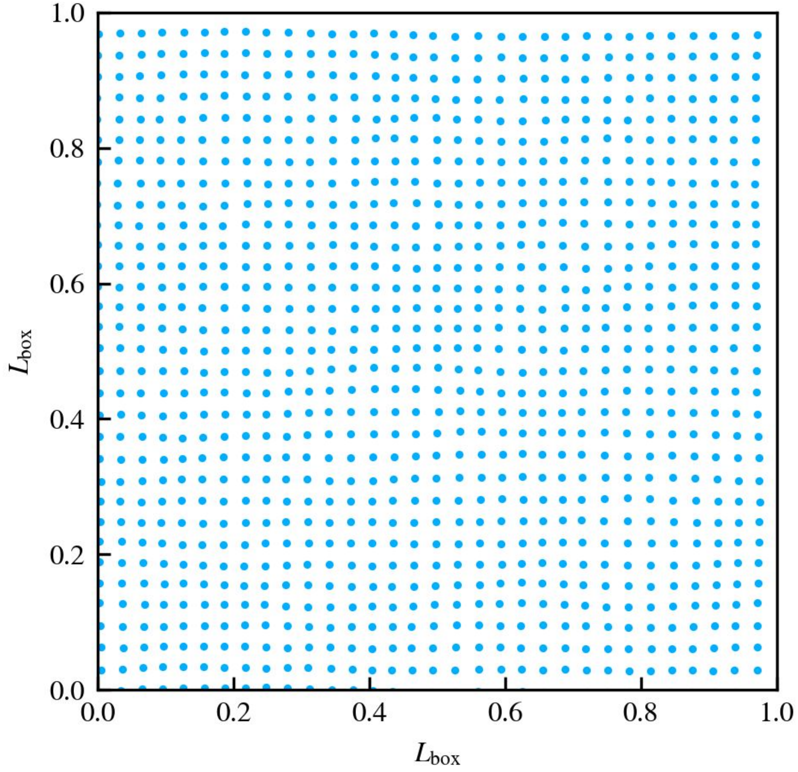

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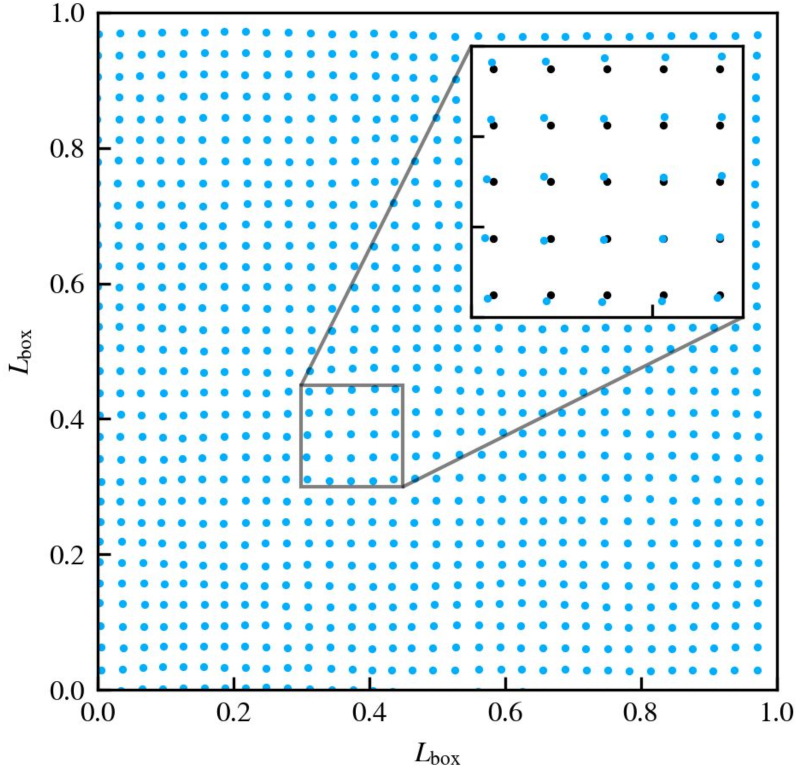

Gravity integration

1. Compute forces.
    - Long range
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2. *Carefully* integrate the orbit of particles, e.g. timestep limiting

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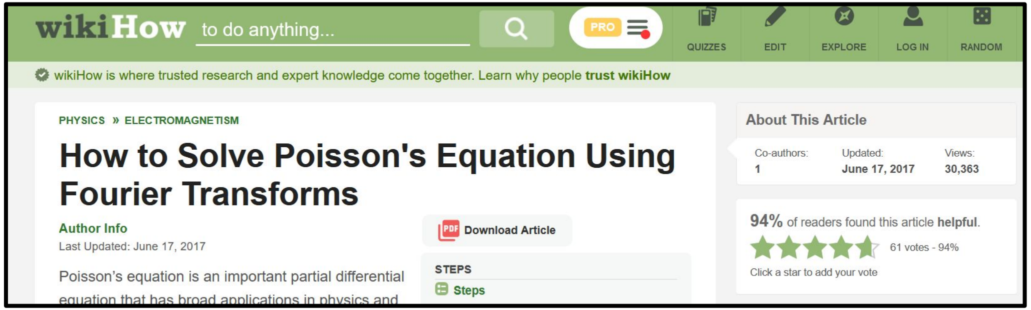
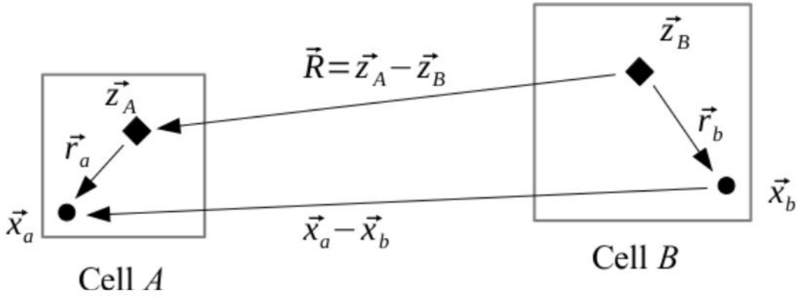
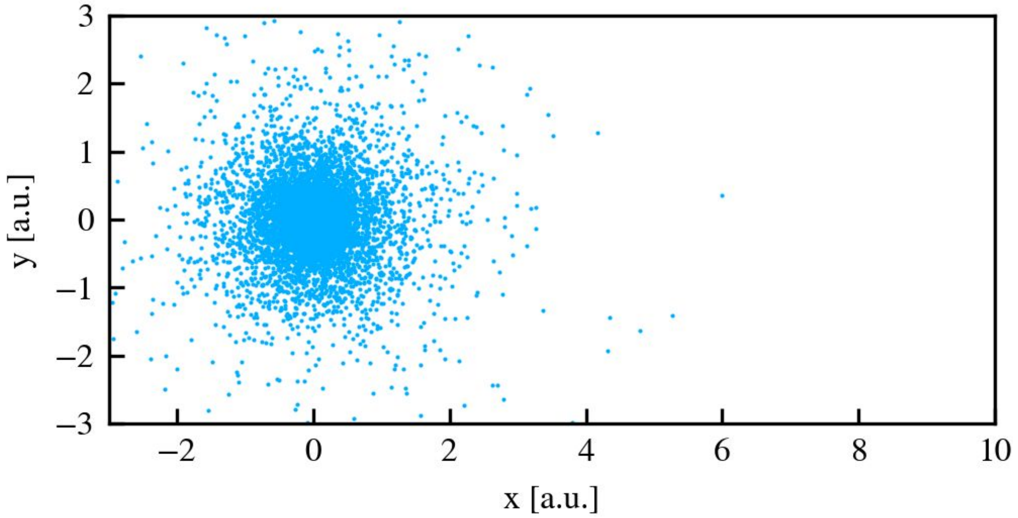




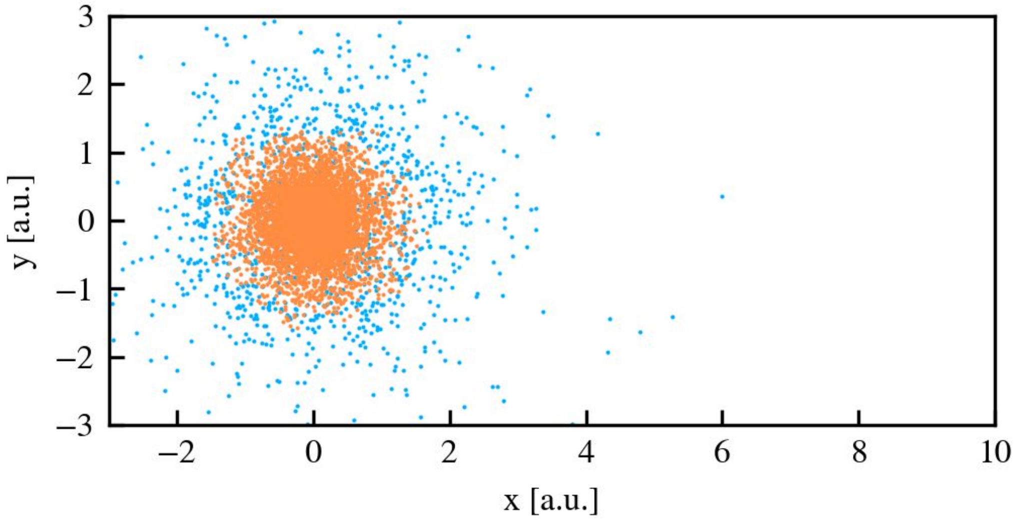
Halo finding



Halo finding

1. Find field haloes (Friends-of-Friends).

2. Identify substructures candidates in FoF groups.



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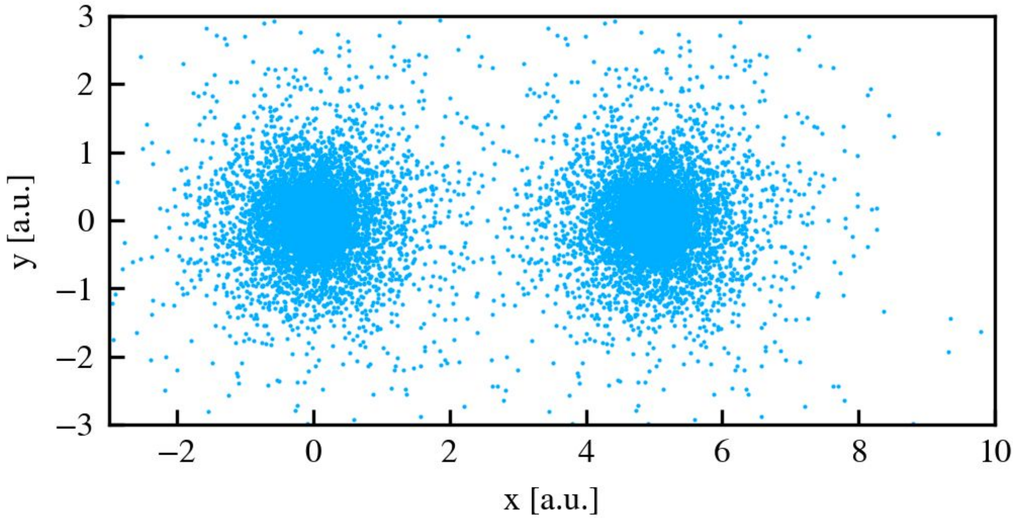

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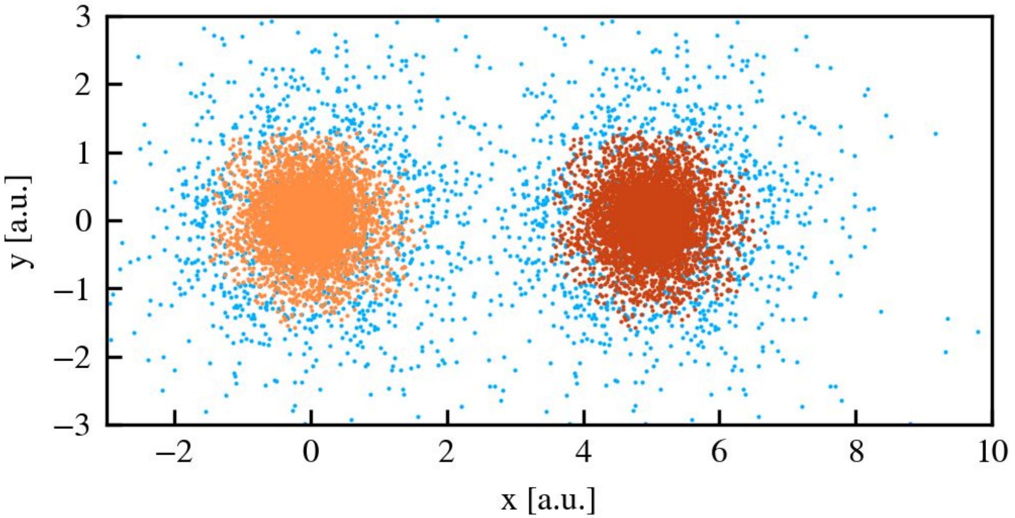

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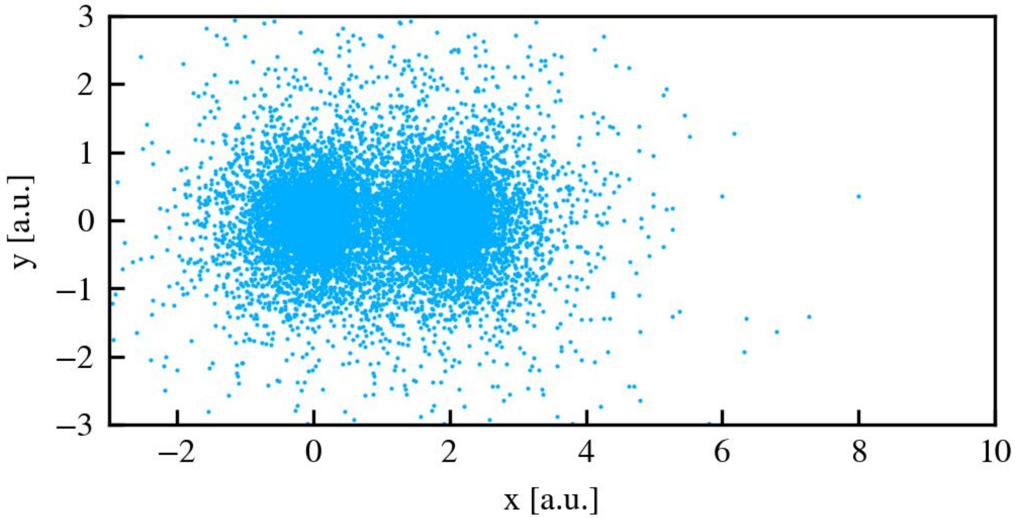

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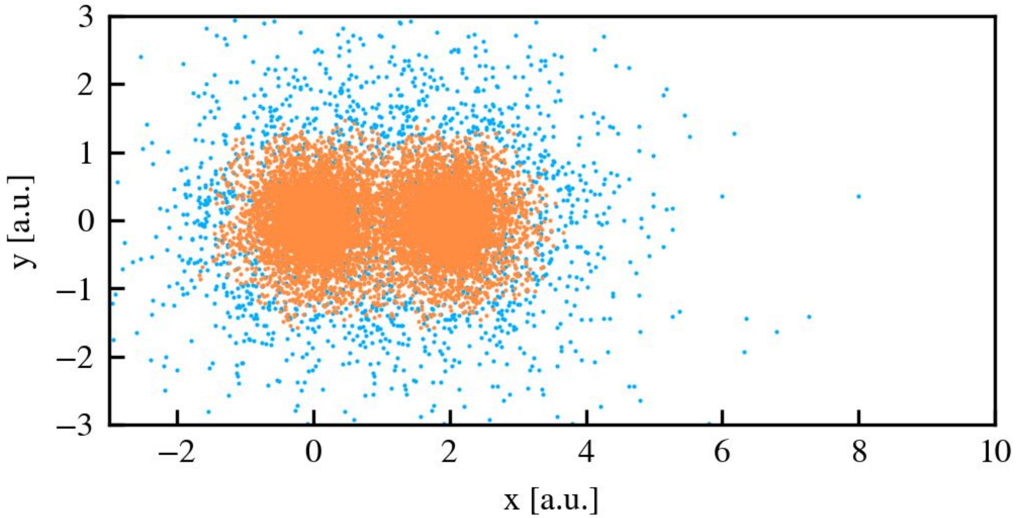


Halo finding

1. Find field haloes (Friends-of-Friends).

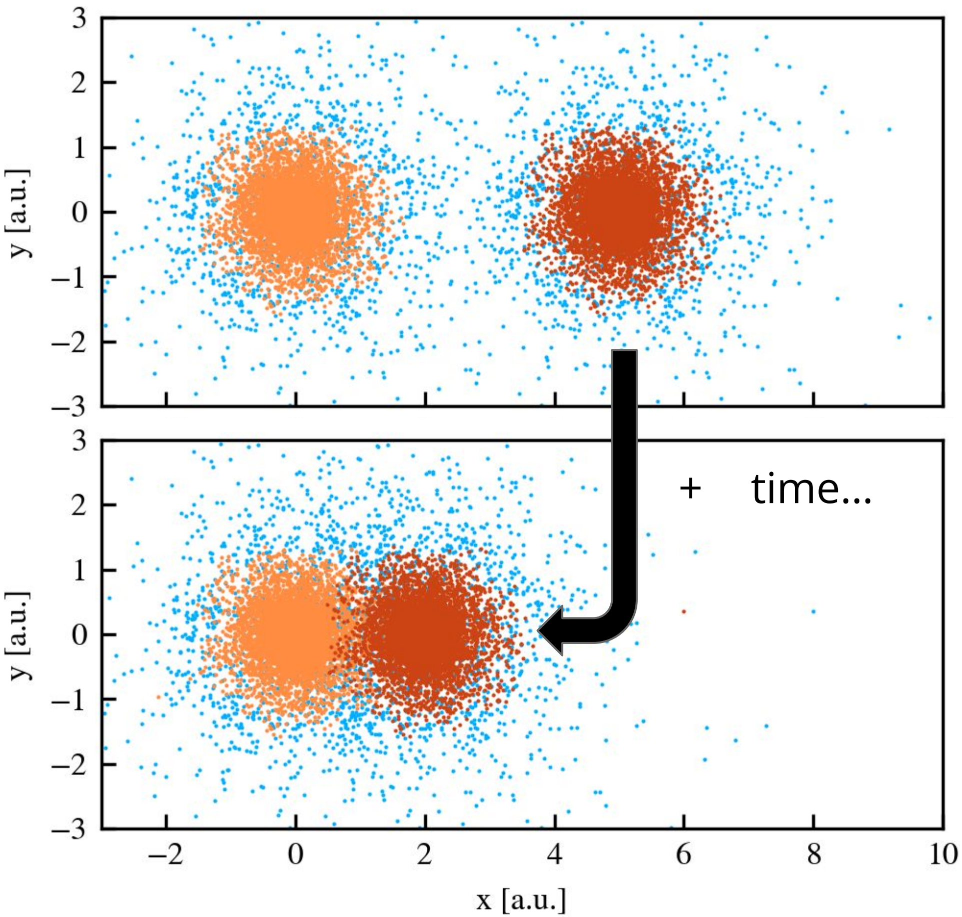
2. Identify substructures candidates in FoF groups.

    - HBT uses past memberships to identify candidates.

3. Check self-boundness of objects.

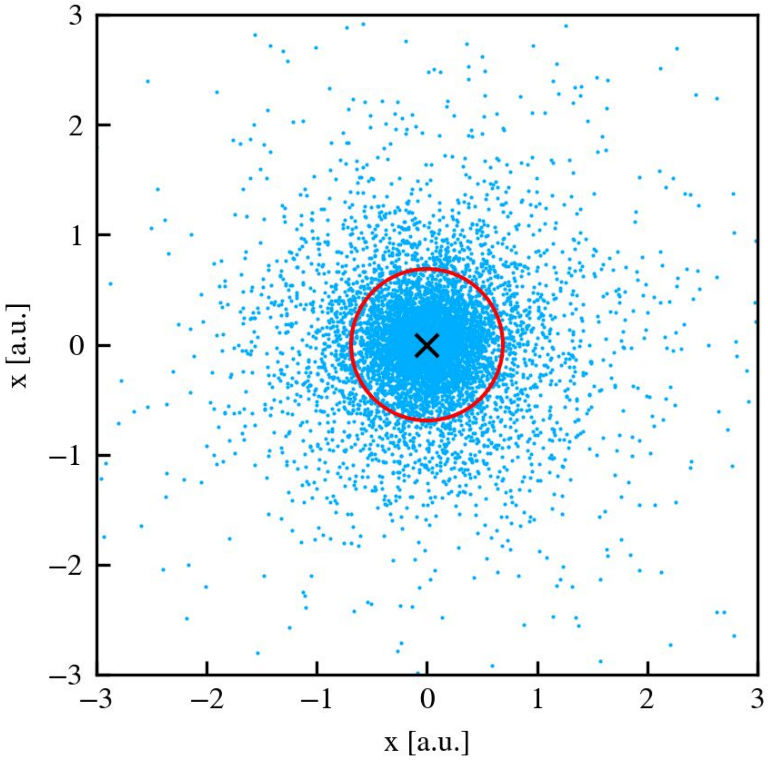
    - Recursively within a FoF.

    - Subsampling if subhalo is large.



Halo properties

1. Inclusive spherical apertures:
    - All particles within aperture.
2. Exclusive spherical apertures
    - Bound particles within aperture.
3. Bound halo properties
    - Particles bound to a subhalo.



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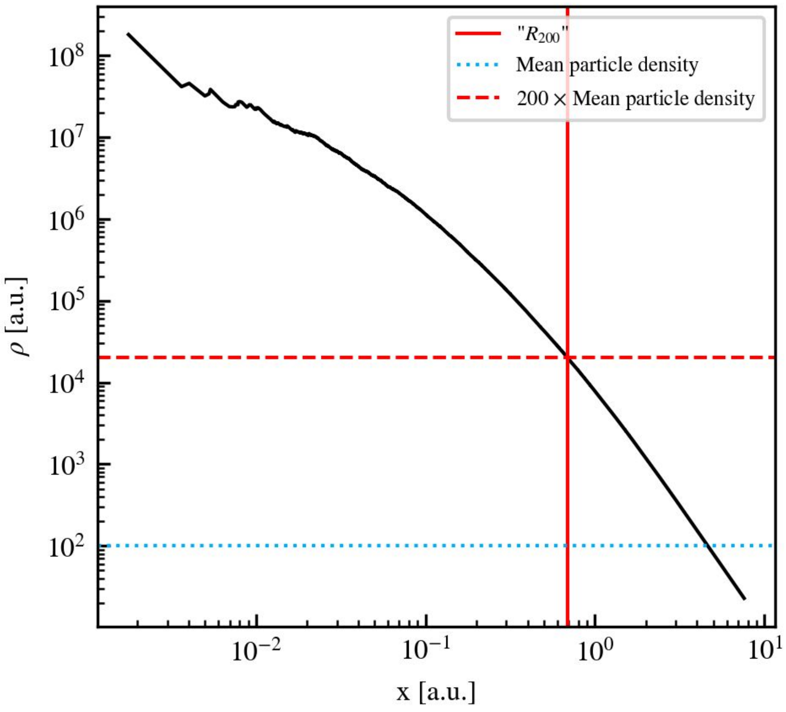
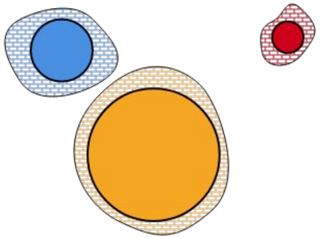
Physical or spherical overdensities



Runtime overview

1. IC generation ~ 1 minute.
2. SWIFT ~ 80 Cpu-minutes.
3. HBT+ ~ 1 minute.
4. SOAP ~ 10 seconds.

HBT: practical example



T = 0

Unique ID	Parent
0	-
1	-
2	-

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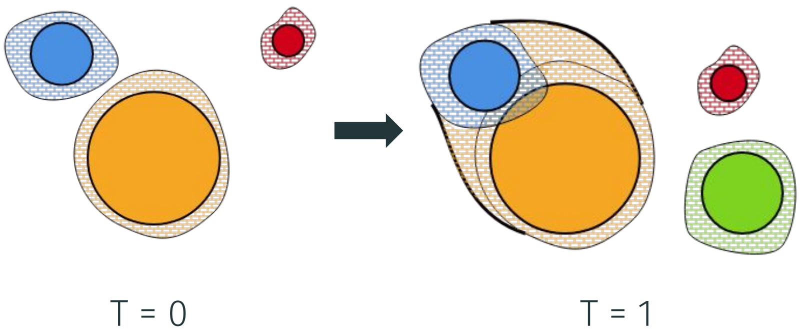

Unique ID	Parent
0	-
1	-
2	-

Unique ID	Parent
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1	0
2	-
3	-

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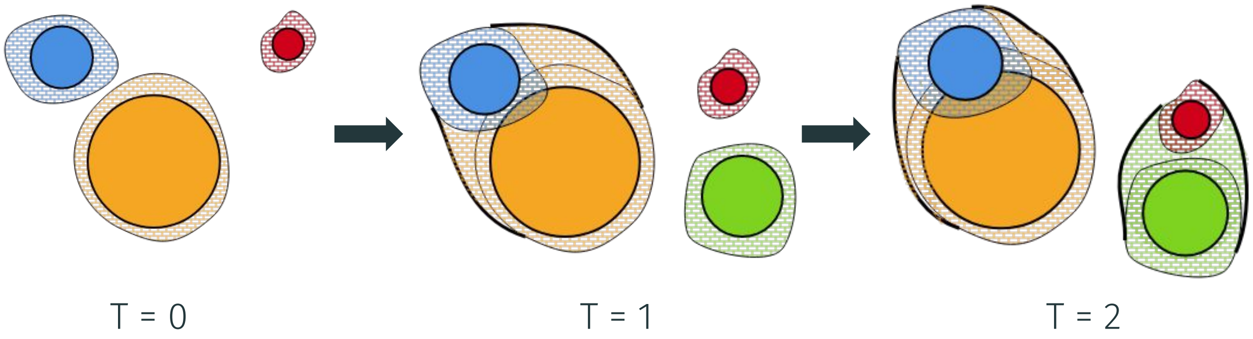

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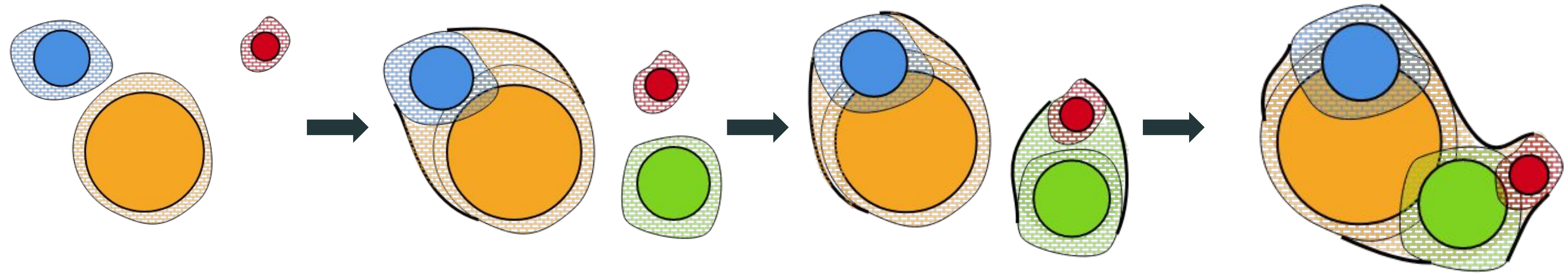

T = 0 T = 1 T = 2 T = 3

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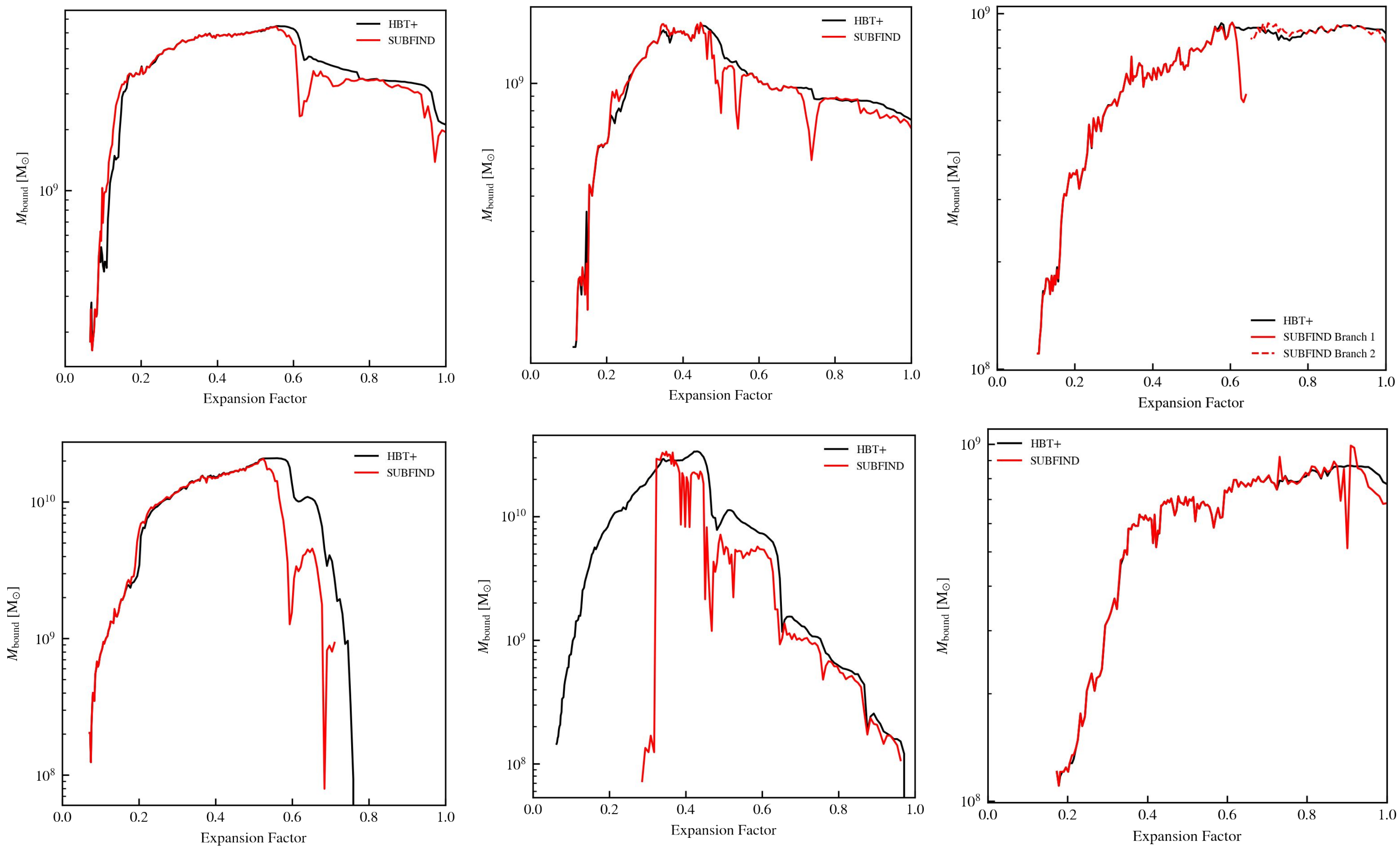
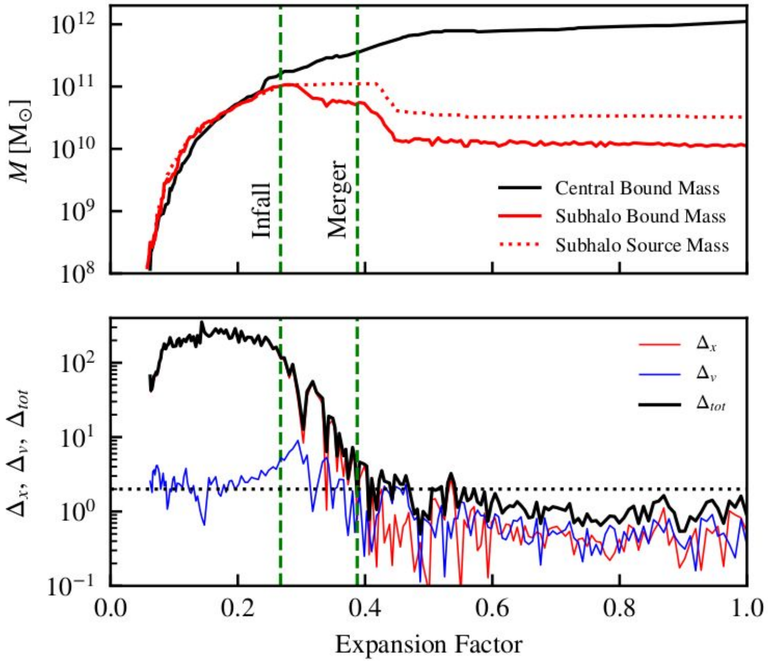
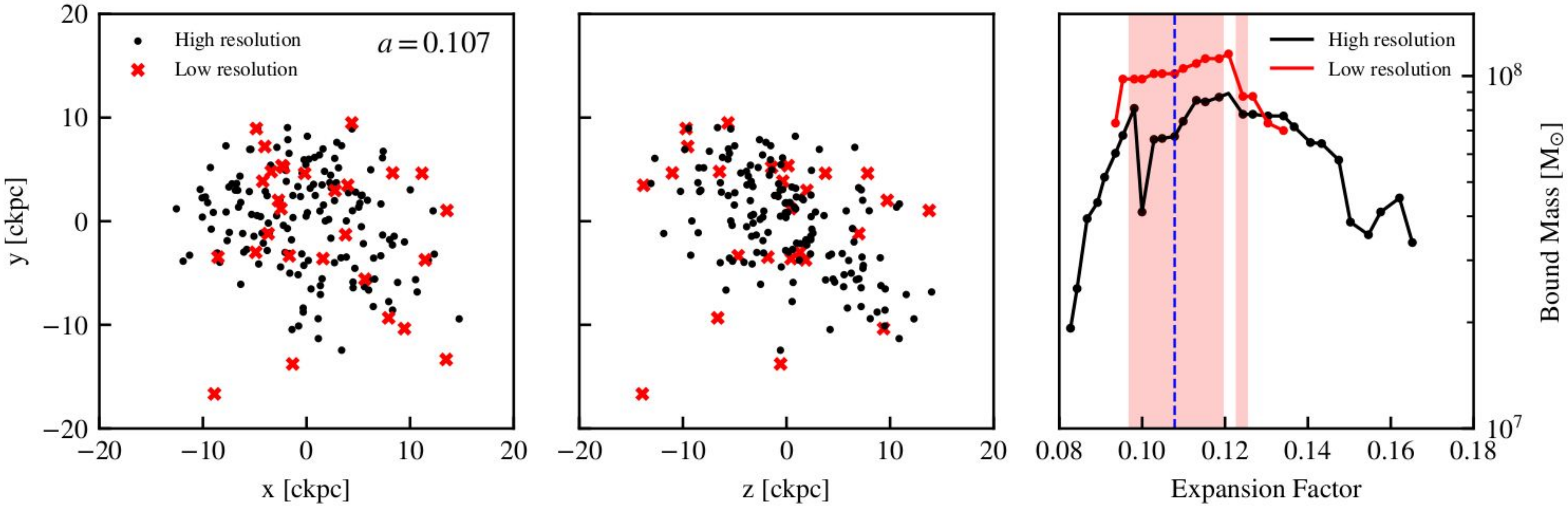
HBT: more robust structure finding



HBT: merger events

- Force merging of subhaloes based on the ‘normalised phase-space distance’ between their ‘most bound cores’





High resolution
Low resolution
a = 0.107
y [ckpc]
x [ckpc]
z [ckpc]
Expansion Factor
Bound Mass [M☉]