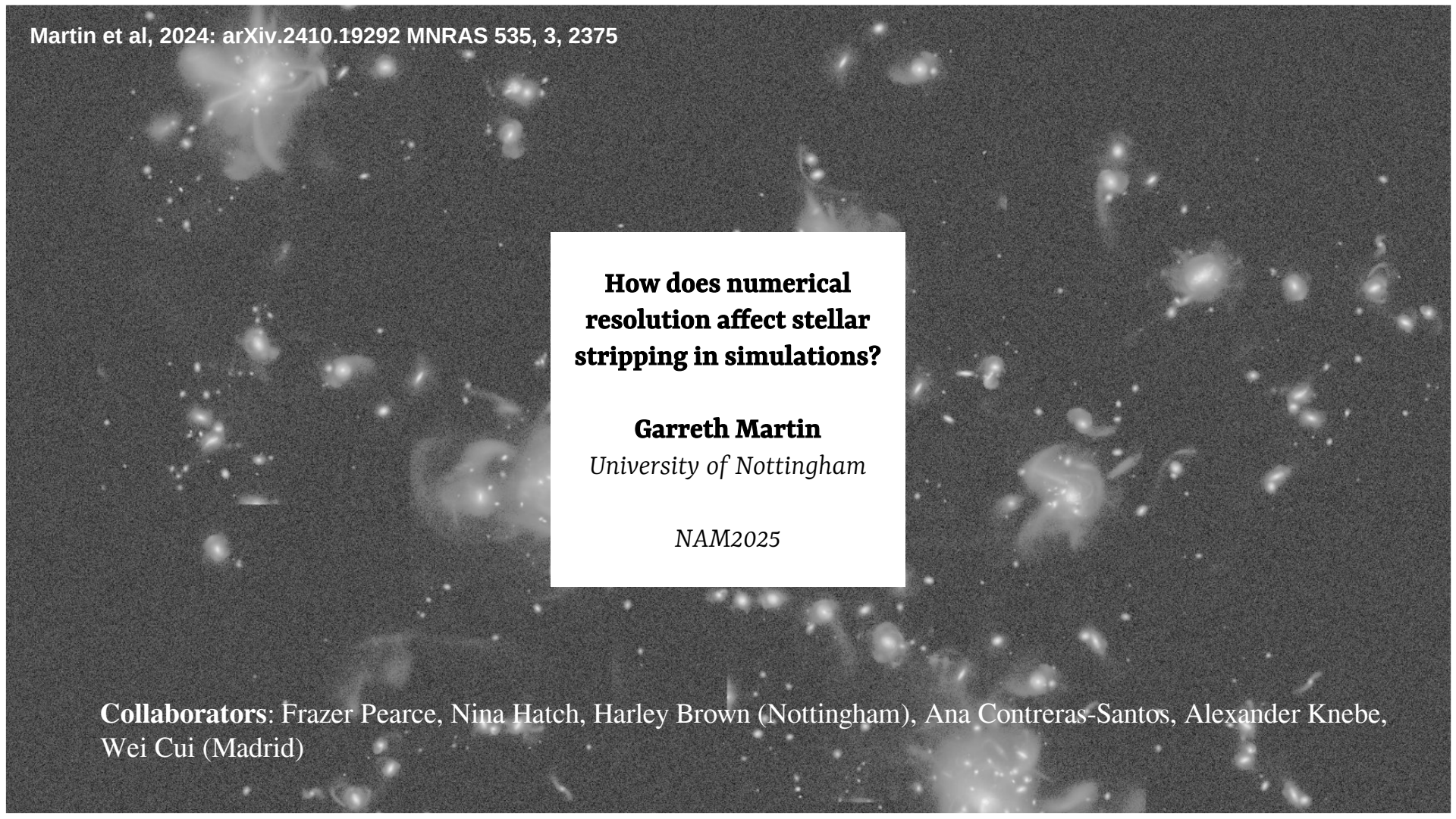

Martin et al, 2024: arXiv.2410.19292 MNRAS 535, 3, 2375

How does numerical resolution affect stellar stripping in simulations?

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NAM2025

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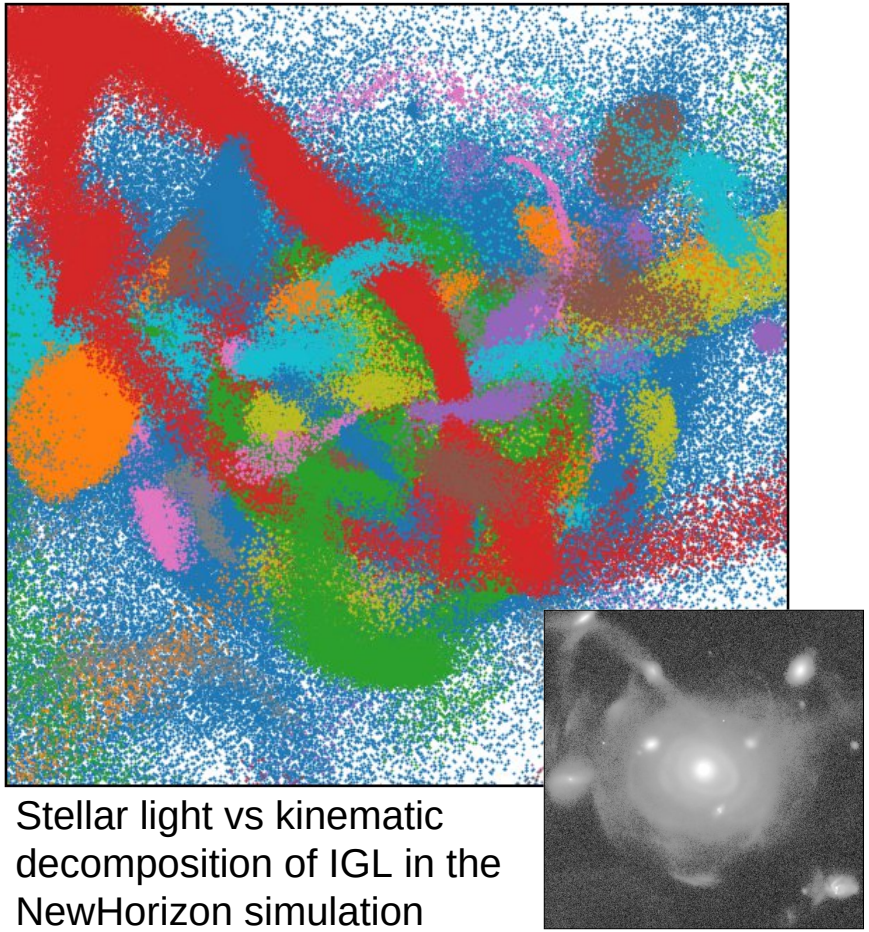
Background

Stellar stripping: stars removed from satellite galaxies by **tidal forces**.

Contributes to **intracluster light,** galaxy stellar haloes and **evolution of galaxies** in clusters.

A majority of intracluster/intragroup light is generated by **tidal stripping** (Brown+2024)

Simulations need to resolve the processes affecting each objects contribution to the ICL to make accurate predictions about its bulk quantity and resolved properties.



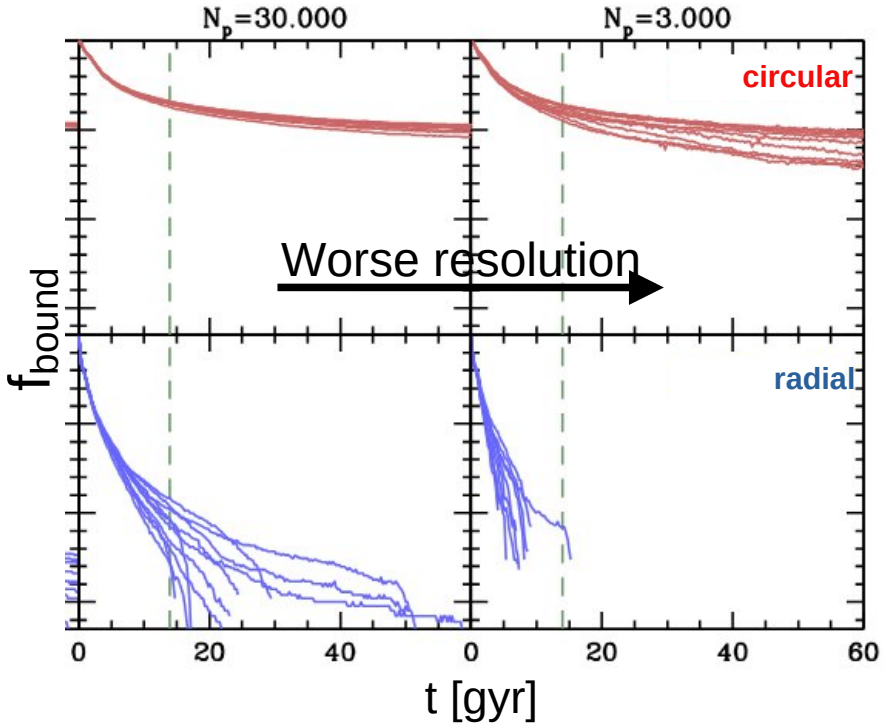
Stellar light vs kinematic decomposition of IGL in the NewHorizon simulation

Background

Accurately resolving mass loss from **DM haloes** requires a **minimum number of particles** to avoid artificial disruption

The impact of resolution on **stellar mass loss rates** has not been explored so-far

Stars are dynamically cooler and more centrally concentrated – potentially more prone to numerical effects



van den Bosch & Ogiya (2018)

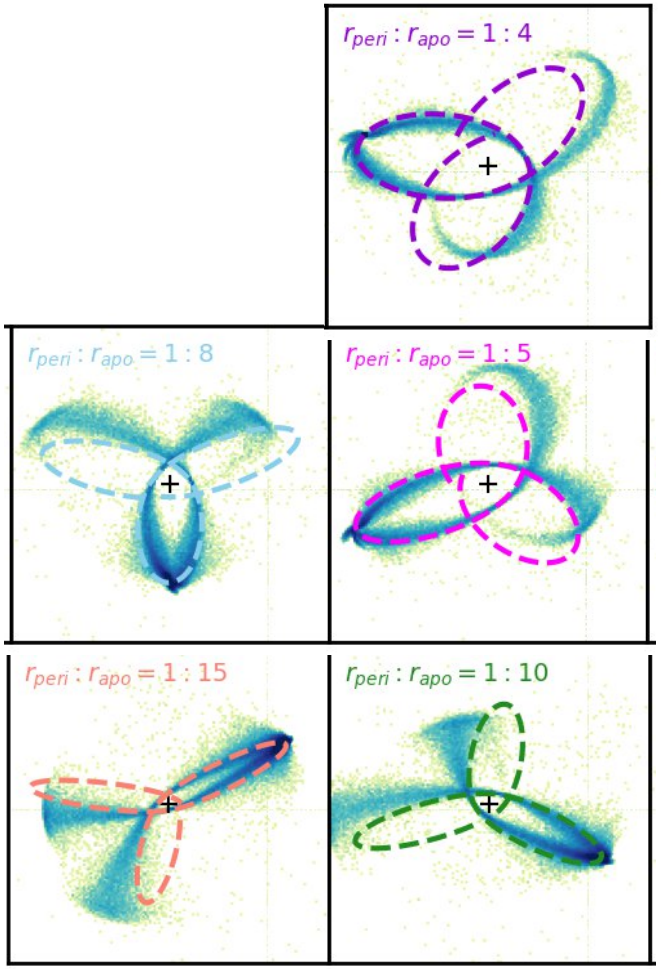
Simulation setup

Host: $10^{14.5}$ Msun modelled as a **static potential**

Satellite: DM halo with stellar component (spheroid and bulge+disc) using GalIC (**Yurin & Springel, 2014**)

Grid of **orbital parameters** and **satellite stellar masses**

Resolution: Grid of **spatial and mass resolutions** over a range corresponding to contemporary cosmological simulations (m_*/m_{DM}): $10^5/10^6$, $10^6/10^7$, $10^7/10^8$ M_{sun}



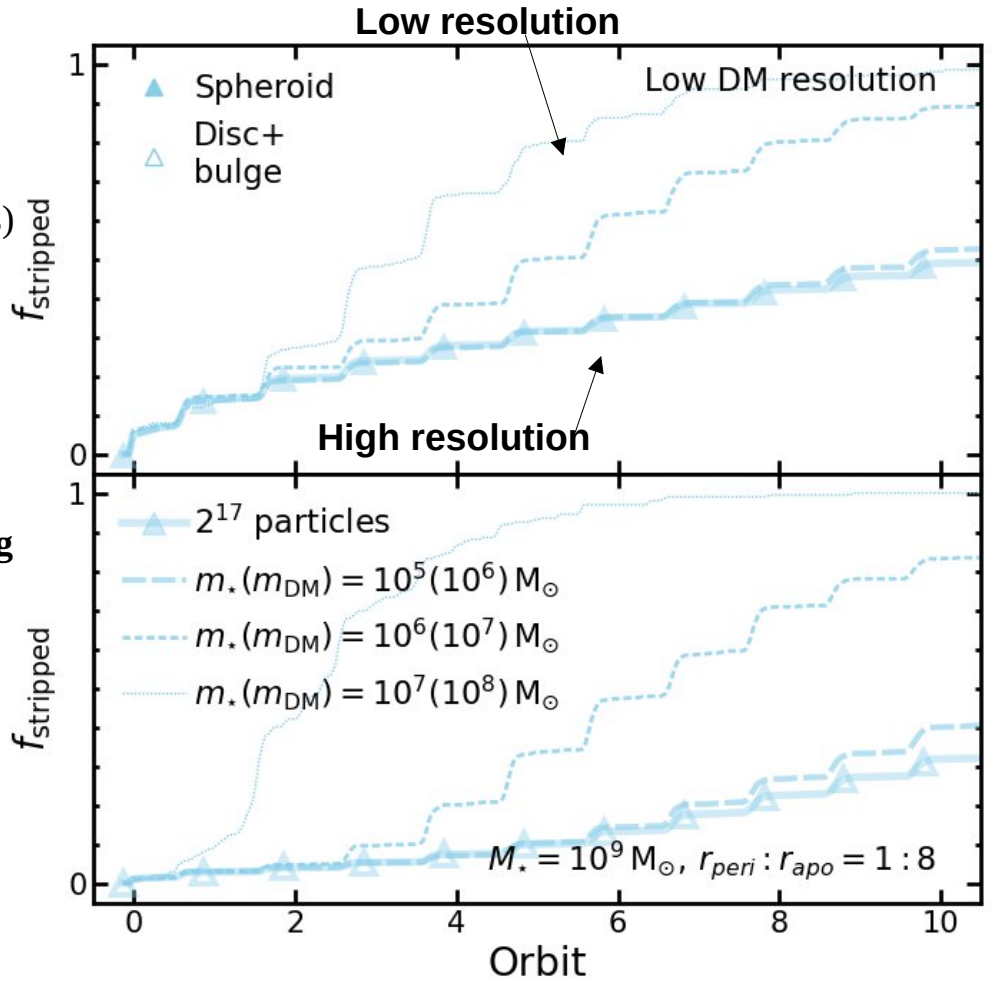
DM vs stellar stripping

Well-resolved DM haloes maintain their structure, while poorly resolved haloes (<1000 DM particles) lead to **cored central profiles**.

The properties of the **satellite DM halo** significantly influence stellar stripping efficiency.

The slope of the inner DM profile near the stellar component impacts stripping rates with poorly resolved haloes leading to **over-efficient stripping**

DM resolution has a large influence on the **stellar component** but **integrated DM properties** are largely unchanged



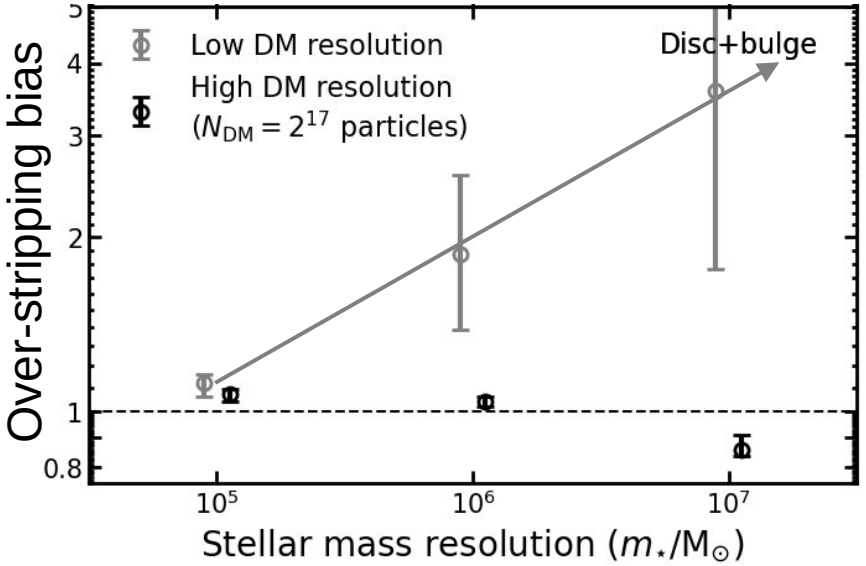
Impact of resolution on ICL production

Poor resolution overestimates the **bulk quantity** of stellar mass stripped.

Accurate stripping rates require **numerical and spatial resolution** for the DM.

High-resolution DM results in **convergence of mass loss rates**

Bias assuming a realistic distribution of satellite masses and infall orbits



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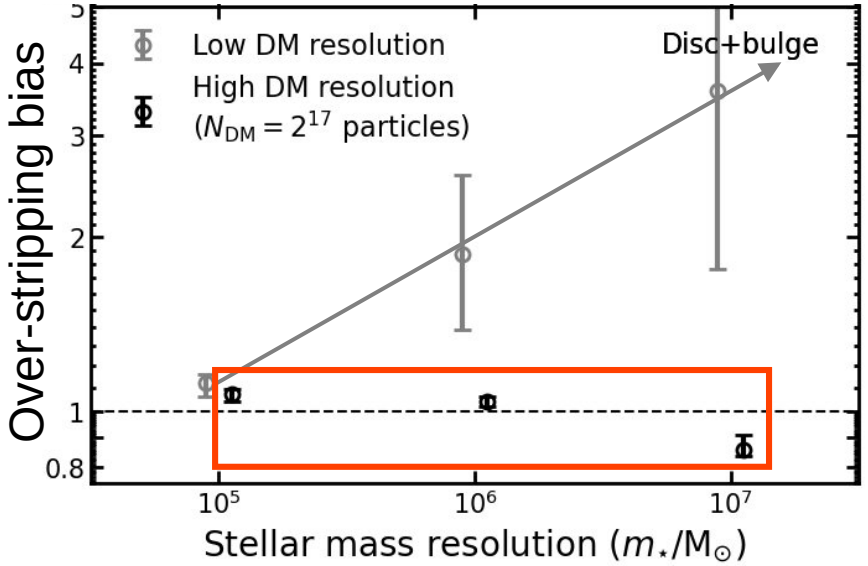

Impact of resolution on ICL production

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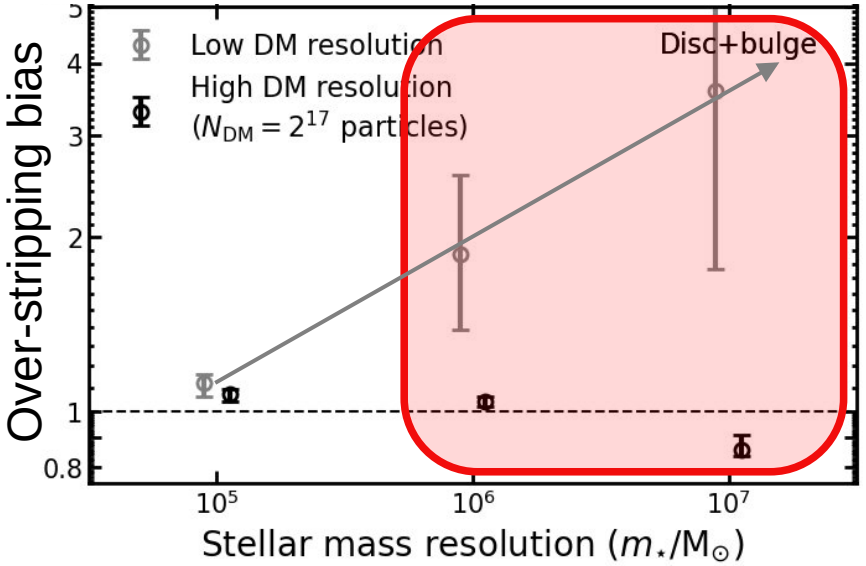
True even when the **stellar component** is poorly resolved.

Current cosmological simulations may **overestimate the bulk quantity of stellar mass** stripped from satellite galaxies.

State-of-the-art big-box cosmological sims (e.g. TNG)



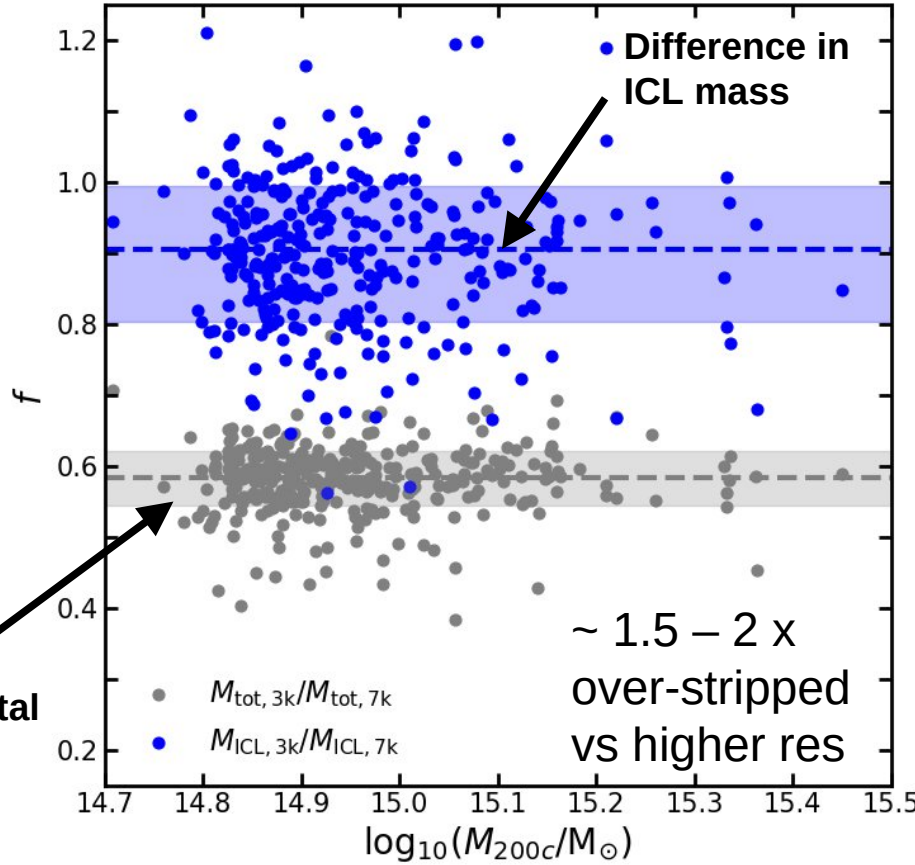
Comparison with cosmological simulations

We observe this effect in **TheThreeHundred**

1.5 - 2 × over-stripping in $m_{DM}=1.5\times10^{9}\ h^{-1}$ M_x005F_x0003_$_{\odot}$ vs $m_{DM}=2\times10^{8}\ h^{-1}\ M_{\odot}$

But over-stripping is concealed by lower star-formation efficiency in lower-res runs!

Change in ICL mass and total stellar mass for low- and high-resolution TheThreeHundred runs



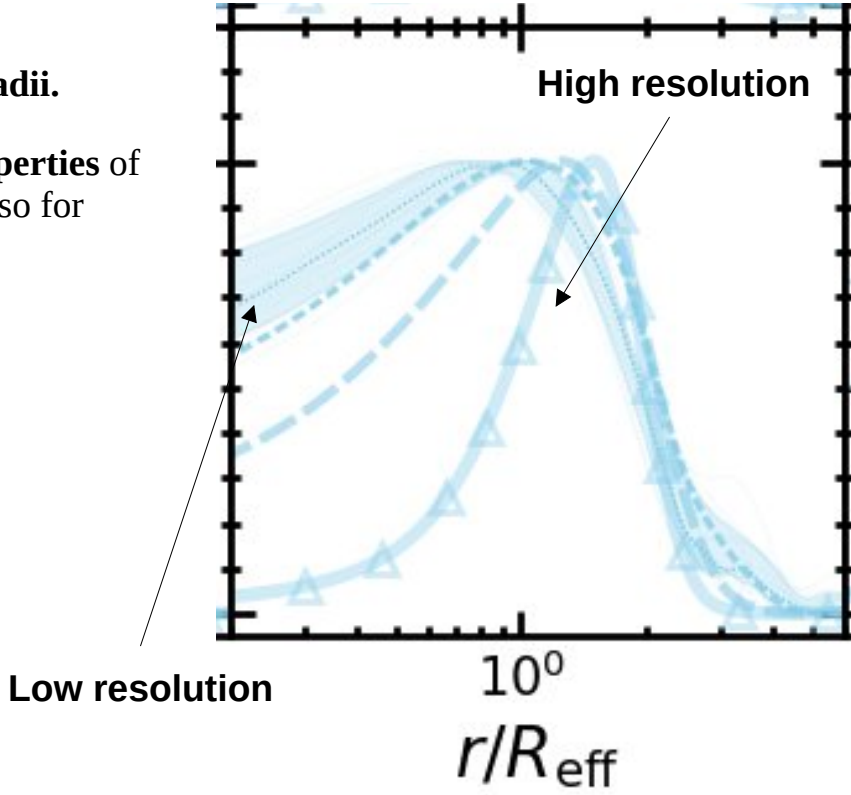
Resolved properties of the ICL and stripped remnant

Stripping radius is also sensitive to numerical resolution.

Poor resolution strips stars originating from **artificially small radii.**

Stellar mass resolution becomes important for the **resolved properties** of the remnant and **radial properties** of stripped stars, but less so for mass loss rate

Location of stellar stripping within the satellite galaxy



Summary

DM resolution is the crucial factor for resolving stellar stripping.

Poorly resolved DM haloes lead to **over-stripping.**

High DM resolution is needed to recover **accurate bulk ICL quantities**

Stellar mass resolution matters most for the **resolved stellar properties** of the tidally stripped remnant

Poor numerical resolution can result in:

Overestimating the bulk quantity of ICL

Biasing the radial properties of the ICL

Inaccurate stellar mass loss rates may impact **tuning of the galaxy evolution model** to reproduce the GSMF

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