Phase mixing process in the accretion of satellite galaxies

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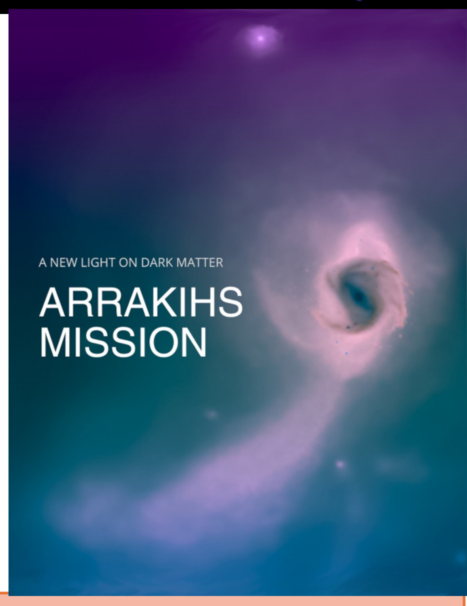
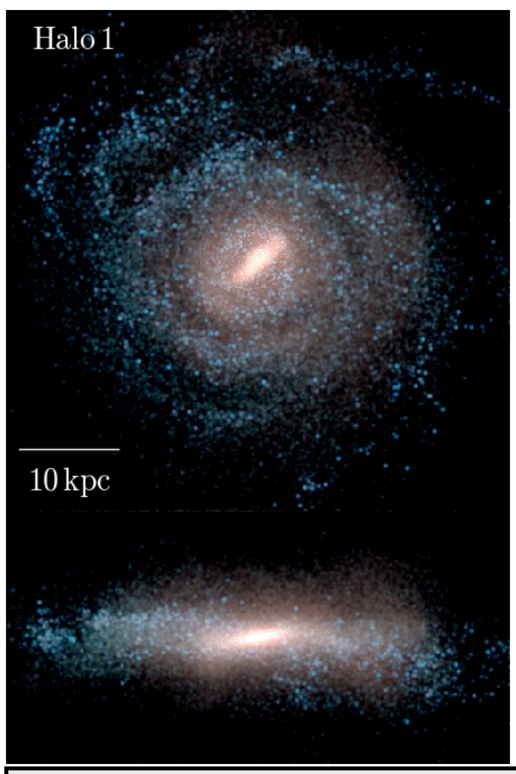




Abstract: One of the most important parameters to know the probability of observing a given stellar or tidal stream is the amount of time it lasts as a stream before virializing with the host galaxy. Using several hydrodynamical simulations, we can estimate the average time each stellar stream remains observable and detect any correlation between this duration and the parent dwarfs' intrinsic and orbital characteristics. We can also probe if there are significant differences in this infall time and relationship for different baryonic, incorporating simulations with varying models.

Simulations

We use the halo 1 in the Original/4 series of Auriga (Grand et al. 2024).
DM resolution: 5.4×10^4 $M_\odot$
Softening length: 375 pc.

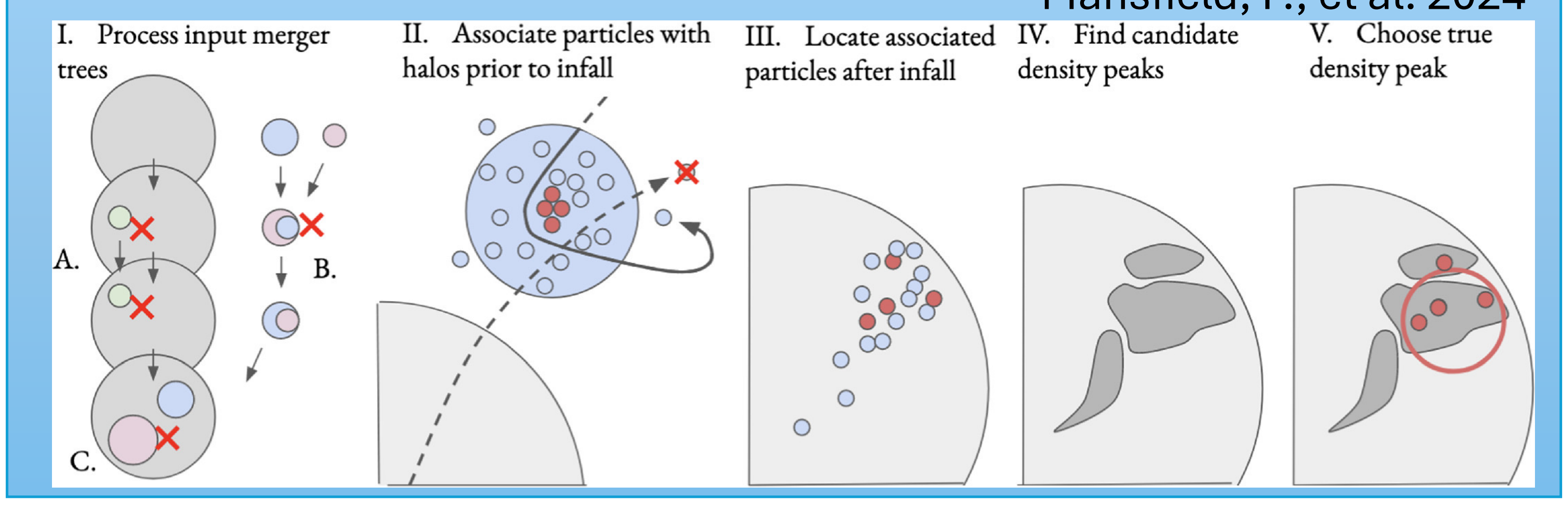
Particle tracking

We use the halo finders Rockstar and Consistent trees (Behroozi et al. 2013a-b) and a corrector algorithm based on Symfind and Sparta (Mansfield, P., et al. 2024 , Diemer et al. 2024). We define a halo as phase-mixed using the algorithm from Riley et al. (2024), using a local velocity dispersion and stellar mass boundary. An extended discussion on this can be found in the poster P.90 by A. Lambarri-Martinez.

Analysed properties

Selected satellites: $N_* > 100$ & At least 1 pericentre.
First $r_{\rm apo}$, $r_{\rm peri}$, orbit angle to main disk α.
c=r_{25}/r_{50} (r_X radius enclosing X% of the stellar mass).
Last two at infall snapshot: crossing of $1R_{\rm vir}$.
For the satellites** phase-mixed at z=0, we define Δt as the time between the infall and the first phase-mixed snapshot. **For the** non-phase-mixed satellites, we define Δt as the time between the infall and the last snapshot **and are, thus, not comparable.

Mansfield, P., et al. 2024



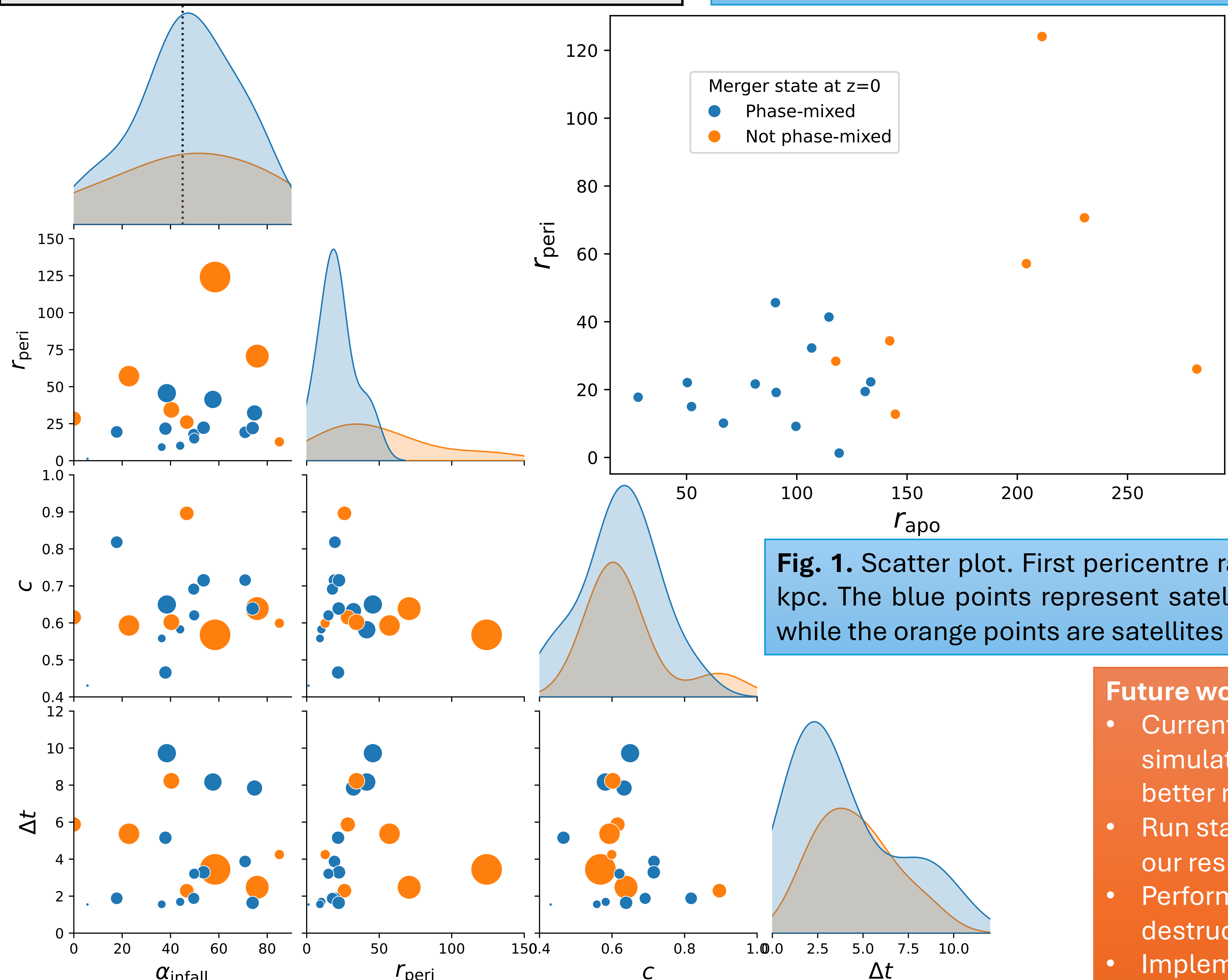


Fig. 1. Scatter plot. First pericentre radius and first apocenter radius in kpc. The blue points represent satellites that are phase-mixed at z=0, while the orange points are satellites not mixed at z=0.

Fig. 2. Corner plot with the correlation between the analysed properties. The diagonal panels include the KDE plots of each feature. The size of the markers scales with the pericentre radius of the corresponding satellite. Colours separate the satellites that are considered phase-mixed at z=0 in blue and those that are not in orange.

Results

- Satellites with higher $r_{\rm apo}$ and $r_{\rm peri}$ do not mix.
- α $_{\rm infall}$ of phase-mixed satellites peaks at 45º.
- Correlation between Δt and $r_{\rm peri}$ for mixed satellites.
- c seems the least important factor.

Future work

- Current dataset is too small → More simulations (Vintergatan, AGORA) and better resolution (level 3).
- Run statistical tests that confirm or falsify our results.
- Perform a detailed study on the destruction-process's evolution.
- Implement a rigorous method of assigning a phase-mixed state to a satellite in function of its dynamical state. See the poster P.90 by A. Lambarri-Martinez.

References

Lambarri-Martinez, A., 2025, P.90 "The currents of space: The effect of baryonic physics on stellar stream formation"
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GitHub with last version of poster (erratum correction).

Acknowledgements

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