Two Sausages, One Bun? GSEs in TNG

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KEY POINTS

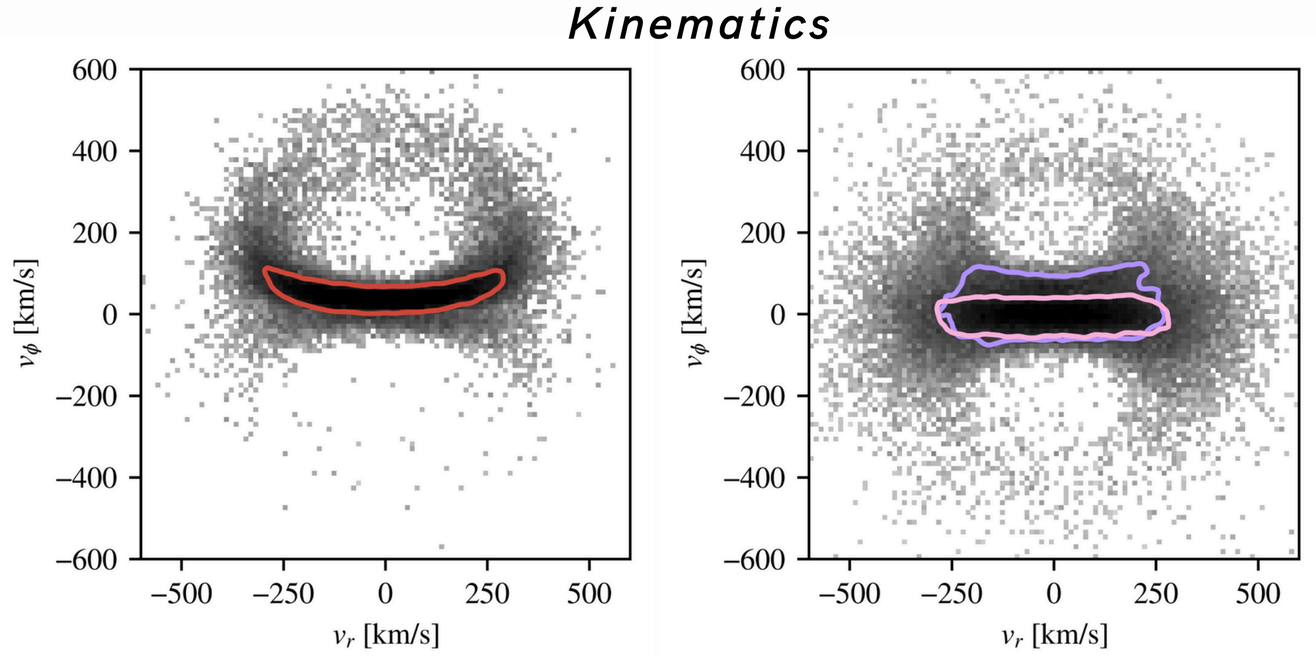
- We analyze stellar accretion histories of 98 Milky Way (MW) analogues in TNG
  - None of these analogues have an LMC, indicating the presence of such a large satellite is rare
  - 32 of these have GSE-like debris
  - One third of the time, this debris comes from a pair of mergers rather than a single merger
- It is difficult to distinguish these cases from one another in common kinematic spaces
- Differences are more evident in star formation histories (SFHs) and chemical abundances
  - One-merger GSEs are accreted more recently than two-merger GSEs (5.9 versus 10.7 Gyr ago, respectively), and this is reflected in their SFH

METHODS

- We identify Milky Way (MW) analogues in the IllustrisTNG simulation by their stellar mass and local environment
- For every star in each MW analogue, we track the galaxy to which it was bound in every snapshot of the simulation. This allows us to associate stars to the mergers which contributed them.
- GSE-like debris is selected with two criteria:
  - it is the largest component of the inner accreted stellar halo
  - it has highly radially-biased velocity anisotropy
- This debris can be comprised of stars from either a single merger or a pair of mergers

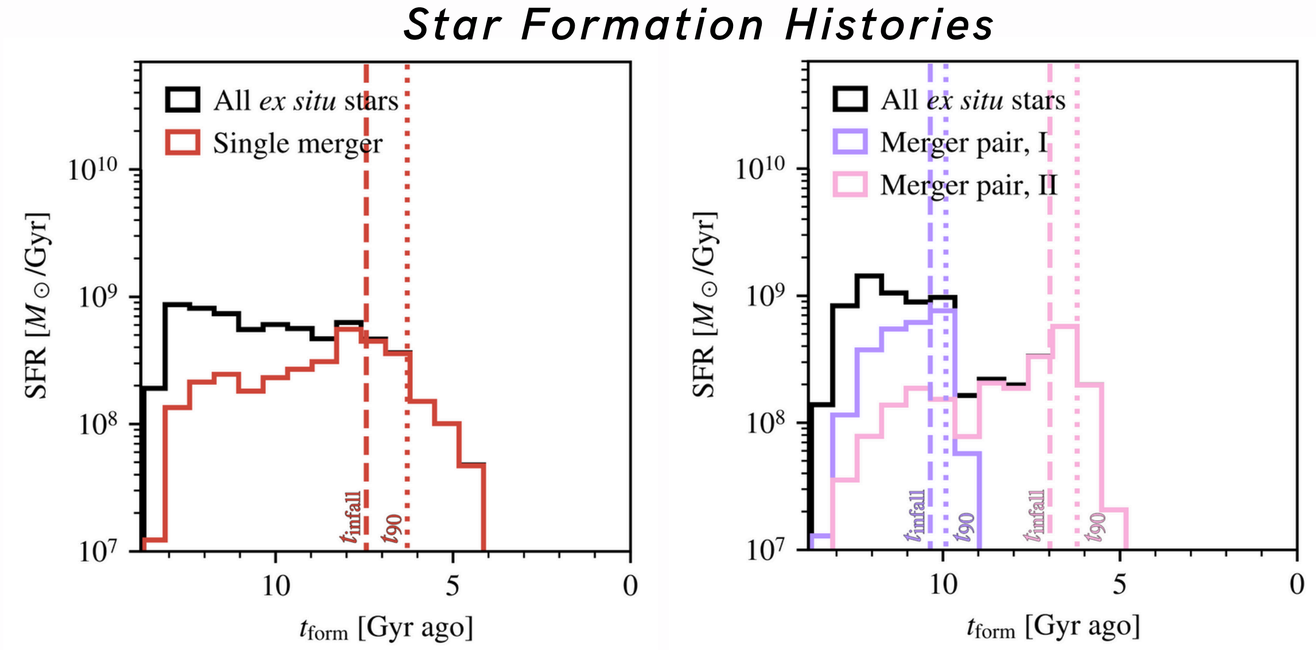
RESULTS

Kinematics

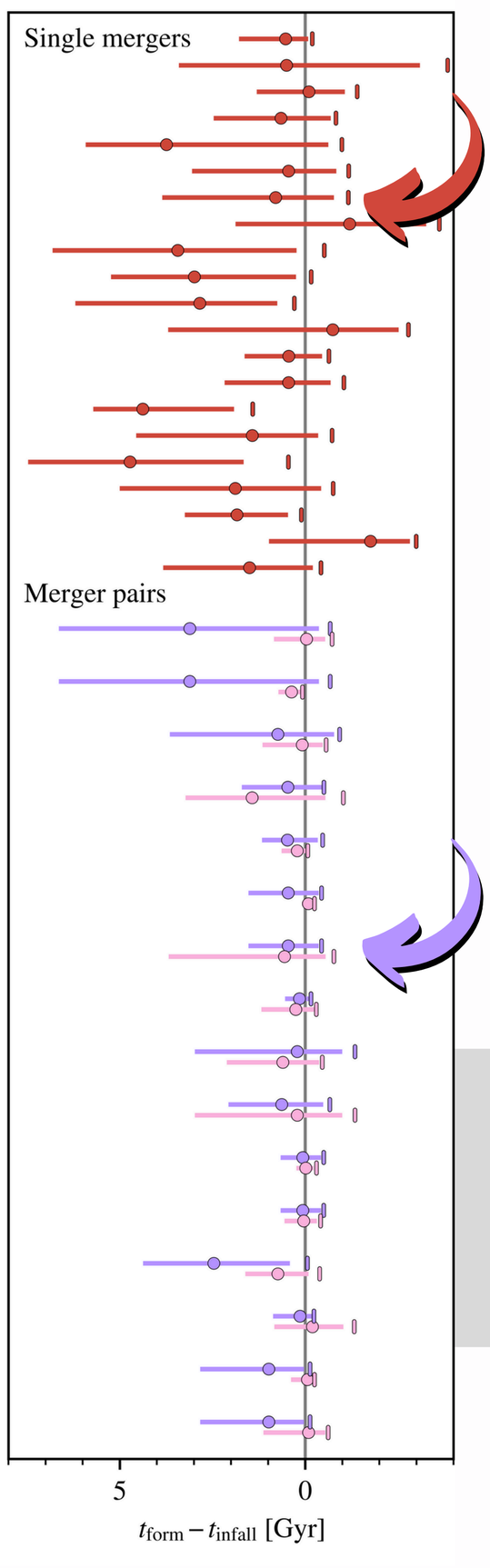


Radial versus azimuthal velocity distribution for a single-merger GSE (left) and a merger pair GSE (right), with the larger of the pair in purple and the smaller in pink. The mergers in the pair lie atop each other in this space, making them difficult to distinguish from a single merger

Star Formation Histories

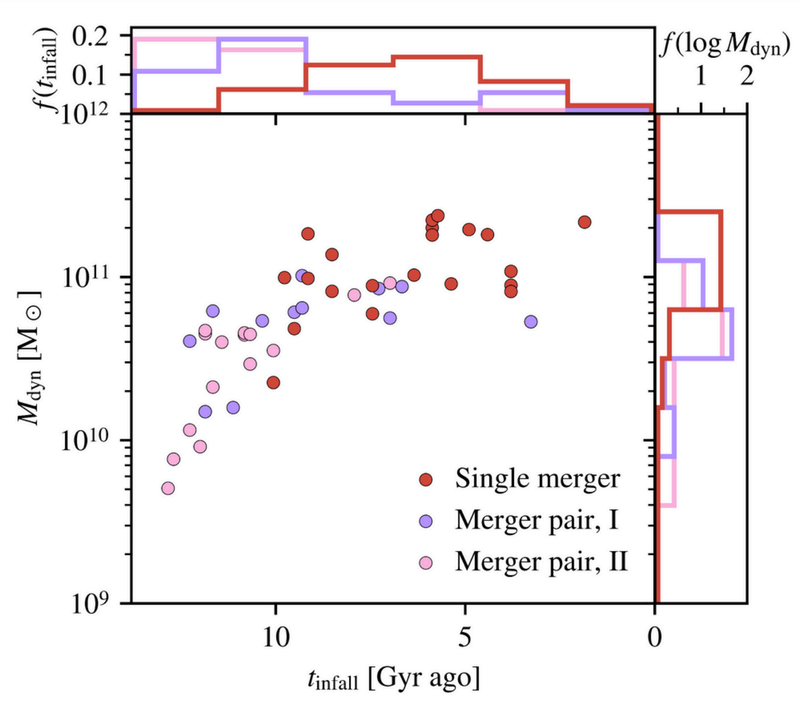


Star formation histories for the same mergers shown above, including the infall times (dashed) and quenching times (dotted) for each dwarf galaxy. Here, the pair are more distinct from each other than in kinematic quantities. Both cases are shown in context with the full sample of GSE analogues in the leftmost figure.



Duration of star formation and quenching time, relative to the infall time of each GSE merger in the sample. The specific cases highlighted above are indicated with arrows. Single mergers form stars longer prior to infall, and frequently continue forming stars well afterward.

These discrepancies are due to systematic differences in the dwarfs comprising one- and two-merger GSEs: the former are more massive and accrete at later times than the latter. This difference is shown in the scatterplot and corresponding marginal probability distributions, in which the median one-merger GSE falls in 4.8 Gyr later and with twice the mass of the median merger in a two-merger GSE.



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