**Terminology**

**Paper 3:**

* **Merger tree:**
  + A merger tree is a representation of the history of haloes. A merger tree is “a graph of chronologically ordered set of subhaloes”. [3] The tree represents the information of haloes over time. A merger tree is a graphical or computational representation of the hierarchical assembly history of galaxies within a simulation. It tracks the formation and merging of galaxies over cosmic time, showing how smaller structures merge to form larger galaxies and how galaxies interact within their host halos. Merger trees are valuable for understanding the evolutionary pathways of galaxies and their connections to the underlying dark matter structure. [1]
* **Halo:**
  + A Halo is “a gravitationally bound structure”. In cosmology, a halo refers to the large, roughly spherical region of space that surrounds a galaxy or a group of galaxies. These halos are primarily composed of dark matter, which exerts a gravitational influence on the visible matter within and around them. In the context of simulations, halos are often used to represent the gravitational potential wells in which galaxies form and evolve. [1]
  + Haloes or progenitors are represented as a nonzero value in the matrices.
  + **Subhalo:**
    - A subhalo is a smaller, gravitationally bound structure within a larger dark matter halo. In the context of galaxy formation simulations, subhalos often correspond to smaller structures that may host individual galaxies or satellite galaxies within a larger halo. [1]
    - A subhalo is represented by a 0.5 in the “subhalo” variable
  + **Main halo:**
    - A main halo, also known as a host halo, is the primary, most massive dark matter halo in which galaxies or substructures reside. Main halos typically represent the largest gravitational structures in the cosmic web and serve as the central regions where galaxies form and evolve. Main halos are often identified as the dominant structures in a simulation volume and can host multiple subhalos.[1]
    - A main halo is represented by a 1.0 in the “subhalo” variable
  + **Differences:**
    - **Size and Mass**: Main halos are generally larger and more massive structures compared to subhalos. Main halos represent the primary gravitational wells in which galaxies form, while subhalos are smaller structures embedded within main halos.[1]
    - **Hierarchy**: Main halos are at the top of the hierarchical structure, representing the most massive halos in a simulation volume. Subhalos, on the other hand, are secondary structures that orbit within main halos.[1]
    - **Galaxy Hosting**: Main halos are often associated with hosting central galaxies, which are typically the most massive and dominant galaxies in a halo. Subhalos can host satellite galaxies, smaller galaxies that orbit within the gravitational potential of the main halo.
    - **Evolutionary Role**: Main halos play a crucial role in shaping the large-scale structure of the universe and influencing the formation and evolution of galaxies. Subhalos contribute to the overall dynamics of the main halo system and can interact with each other through mergers and tidal interactions[1]
* **Progenitor:**
  + “The remaining haloes in a merger tree are dubbed progenitors”
  + In the context of galaxy formation and evolution, a progenitor refers to a galaxy or structure that precedes or gives rise to another galaxy through processes such as mergers or accretion. Progenitors are typically identified in merger trees, which track the hierarchical assembly history of galaxies over cosmic time.
  + When studying galaxy evolution using simulations or observational data, researchers often trace the progenitors of a given galaxy to understand how it formed and evolved. By analyzing the properties and characteristics of progenitor galaxies, scientists can gain insights into the growth and transformation of galaxies over different epochs.
  + Progenitors play a crucial role in understanding the formation mechanisms, morphological changes, and evolutionary pathways of galaxies in the universe. Tracking progenitors through merger trees allows researchers to reconstruct the history of individual galaxies and explore how they have interacted, merged, or evolved over time. [1]
* **Main branch:**
  + The main branch is the largest branch of a merger tree. It contains the biggest progentiors in terms of mass, which is expected to be the main halo.[3] The left-most branch in the merger tree represented in this paper are the main branch.
* **Subbranch:**
  + Other branches than the main branch is called subbranches. These branches contain progenitors but are at one point “merged” into the main branch. Branches are represented as columns in this paper. A merger tree of size 29 x 10 can at most have 10 branches, where one branch is the main branch.
* **Snapshot:**
  + Snapshots are a representation of time when incidents happen in the merger tree. Snapshots are represented through rows, so one row equal one snapshot. A merger tree of size 29 x 10 have at most 29 active snapshots, where active means there are a progenitor present at that row. The last row represents present day.
  + In the context of cosmological simulations and observational studies of galaxy formation and evolution, a "snapshot" refers to a specific moment or state in time that is captured and recorded during the simulation or observation process. Snapshots are essentially snapshots of the simulated or observed universe at different points in its evolution.[1]
* **Last descendant:**
  + The last descendant is the progenitor in the main branch in the last row (present day). This is the halo that the mass assembly history of the merger tree informs about. [1]