

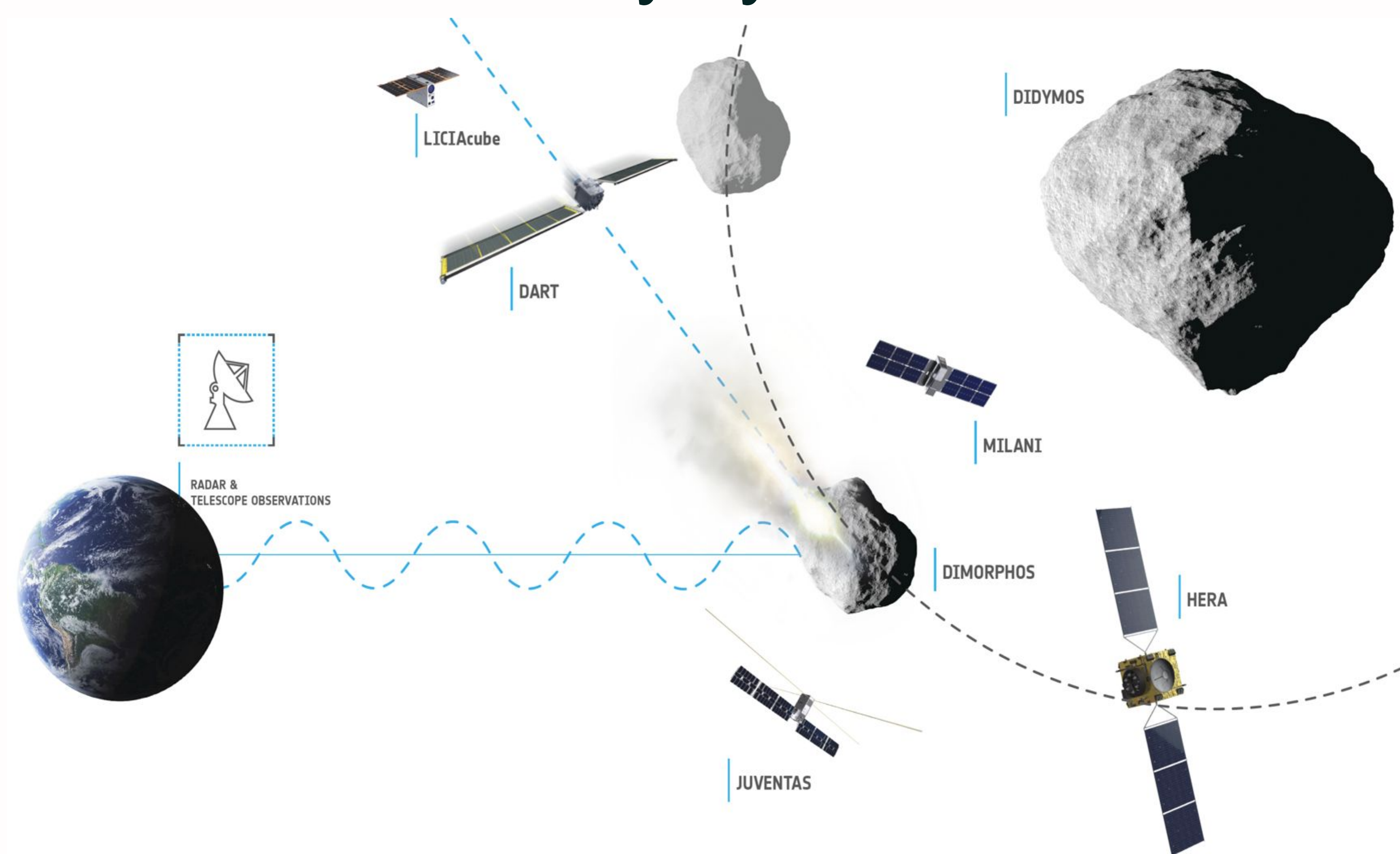
# Origin of the Didymos binary system: Insights from SPH simulations



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## Rotational-induced structural failure may lead to the formation of the Didymos binary system



- The Didymos Binary system consists of a main asteroid, Didymos, and its satellite Dimorphos
- It has been targeted for the DART mission<sup>[1]</sup> to deflect Dimorphos and later will be investigated by the HERA mission
- The binary system could result from rotational-induced structural failure of a primary asteroid<sup>[2,4]</sup>
- Simulating this process can give us insight to the properties of Dimorphos

## We use Bern SPH code to simulate rotational breakup

- We use the Bern smoothed particle hydrodynamics (SPH) code<sup>[5,6]</sup> to model the disk-induced moon formation scenarios
- It includes self-gravity and a strength model for granular materials

## Main body is set up with boulders and matrix material

- We follow Sugiura (2021)<sup>[3]</sup> using the same equation of state and friction angle setup to mimic cohesion
- Unlike their work, we add boulders into the initial body and have a different material sound speed

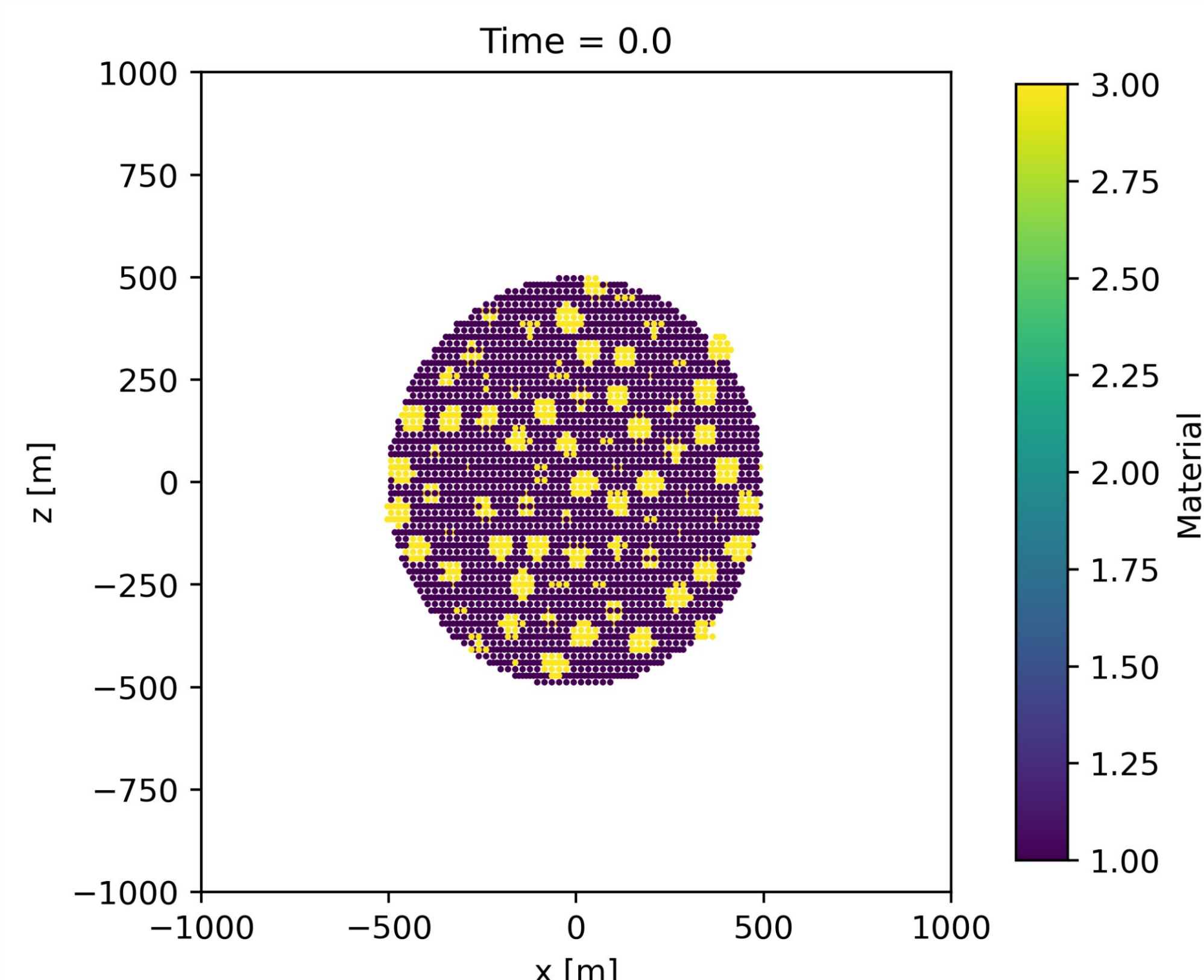


Figure: Slice plot of the initial body setup in XZ plane. Purple points represent matrix particles and yellow points are the boulder particles. The boulder size, distribution and density are varied.

## An example simulation of rotational failure leading to disk and moon formation

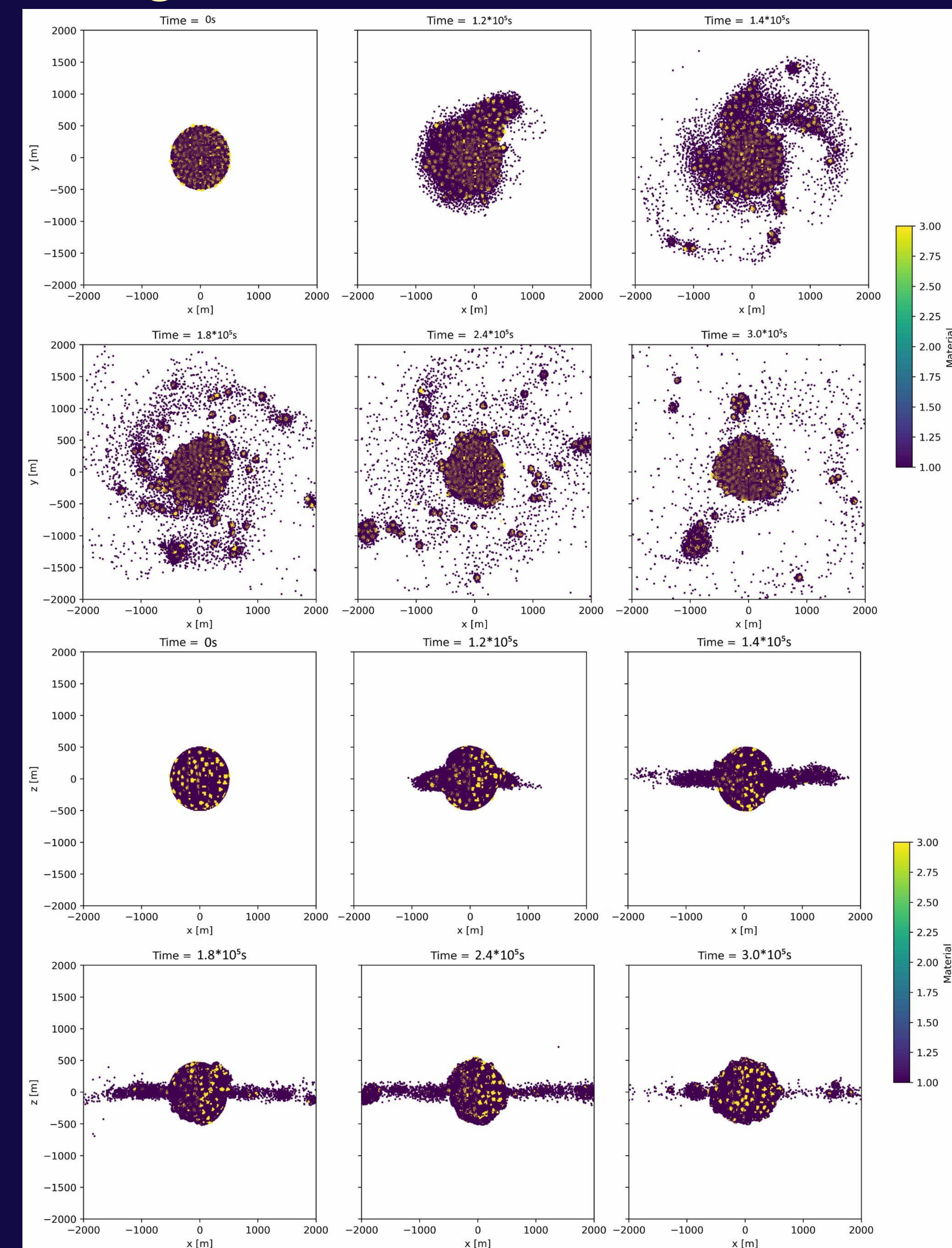


Figure: Snapshots of XY and XZ plane. We use effective friction angle  $80^\circ$  and 5.2m boulder size with the boulder mass fraction 19.5%

- Early disk evolution after landslide shows a top-shaped primary asteroid and an oblate shaped moon
- Boulders accumulate matrix material around them during collapse and later they combine to form a moon

## Cumulative mass distribution after structural failure

- Analysing the mass distribution shows a clear trend for the different boulder mass fractions
- Lower boulder mass fraction increases the accumulated strain and leads to a larger and heavier disk
- Higher boulder mass fraction leads to more internal deformation

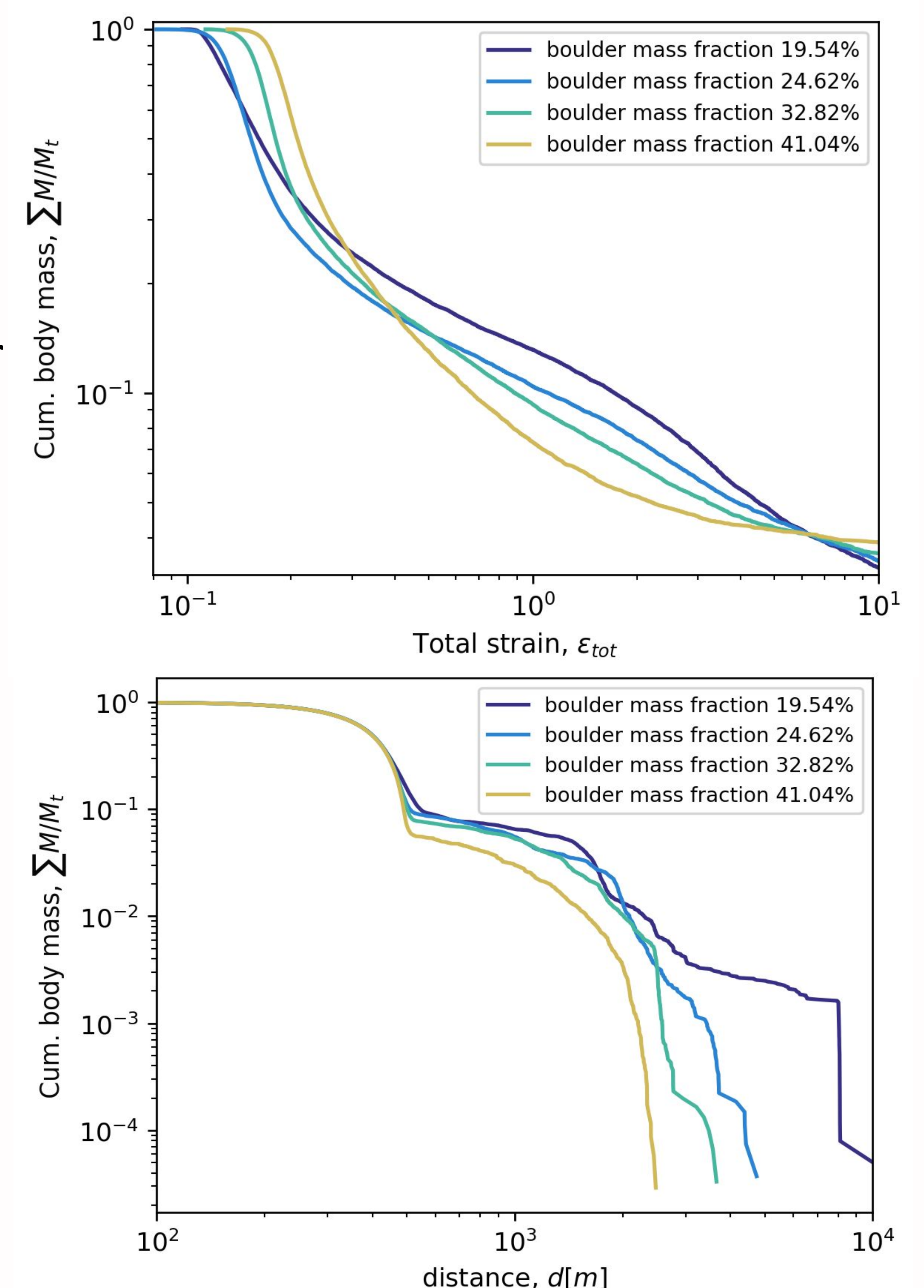


Figure: cumulative mass as a function of total strain and distance. The plots represent four different mass fraction runs while keeping the volume constant.