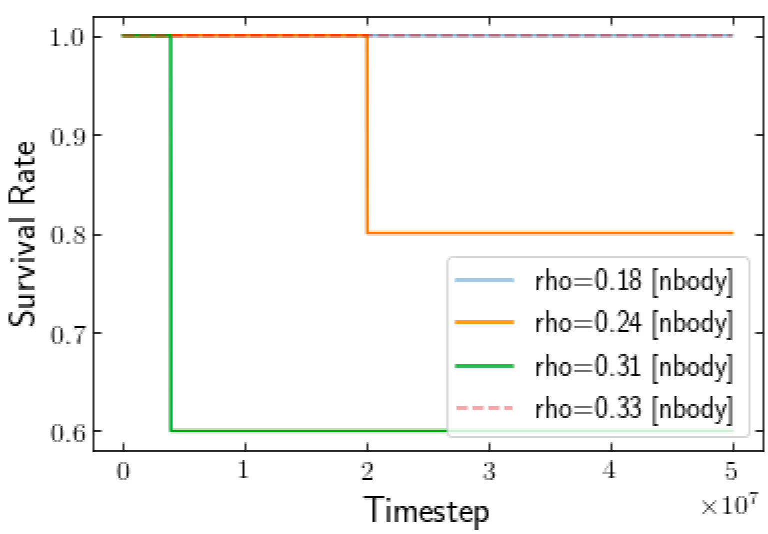
During the collapse of a molecular cloud, star clusters form which range in size from tens of stars to hundreds of thousands of them. The stars which formed in these clustered environments either split up soon after formation or continue to evolve as a cluster. Eventually the cluster itself will dissolve, and all that is left is a stellar stream. With over 4,000 confirmed exoplanets listed in the exoplanet encyclopedia, only 30 were detected in star clusters as of July 2019. The rarity of planet detection in star clusters is contradictory to the theoretical expectation, since it is generally accepted that planet formation is a byproduct of the star formation process, which is prevalent in star clusters. Previous analyses of planetary systems in star clusters show that there are multiple factors which contribute to their disruption. For example, planetary systems in the denser regions of a cluster are more likely to experience stellar encounters, where a nearby star - called a perturber - excites the planets to higher eccentricities, or ejects them. In general, outer planets with larger semi-major axes experience greater disruptions than inner planets.

To analyze the probability of a planetary system surviving around its host star, direct N-body simulations are done. For each planetary system, we monitor the eccentricities (the amount by which the planet's orbit deviates from a perfect circle) and inclinations (tilt of planet's orbit). We also monitor how many planets do or do not get ejected from the system during their evolution. We simulated an isolated star cluster with 16,000 stars containing 200 host stars hosting 5 planets each. The figure shows survival rates of planetary systems with varying local densities, where the local density of a host star or planetary system is the mean stellar density in the vicinity of the planetary system. A higher density corresponds to a smaller distance from the centre of the cluster.



We find that planets orbiting stars that experience higher local densities can be excited to high eccentricities or stripped from their host, and that stars orbiting farther from the cluster centre are more likely to host planetary systems than inner ones. We hope to extend this analysis to a larger suite of star cluster simulations and planetary systems. We want to simulate clusters of various sizes in tidal fields and also experiment with different initial conditions of the planetary systems. We also aim to take it a step further and simulate a cluster to its dissolution into a stellar stream and find the probability of observing planetary systems in these streams.