Planetesimal formations

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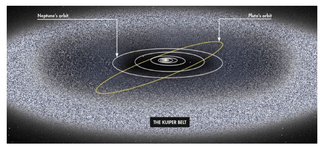
Background

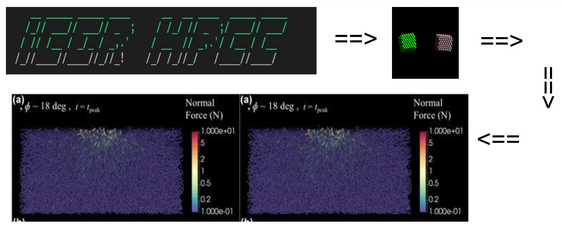
- During the early stages of the Solar System, a swirling nebula of gas and sub-mm dust was transformed into objects such as planetesimals that we observe today.
- In these stages of transformation, growth as a result of pairwise collisions is no longer effective when objects reach cm-sized pebbles due to growth barriers. While growth to planetesimal sizes(1 km - 100 km) can occur via gravitational collapse.

Objectives

- Vary the initial random velocities to consider the influence of turbulent mixing in the protoplanetary disk.
- Analyze how these independent variables affect the efficiency of planetesimal accretion, including the final mass converted into planetesimals.
- The number of accreted planetesimals, and the multiplicity of planetesimal systems (binary, ternary, etc.).
- Compare these binaries to that of the cold classical Kuiper Belt Binaries.



Methods



Results

Figure 1

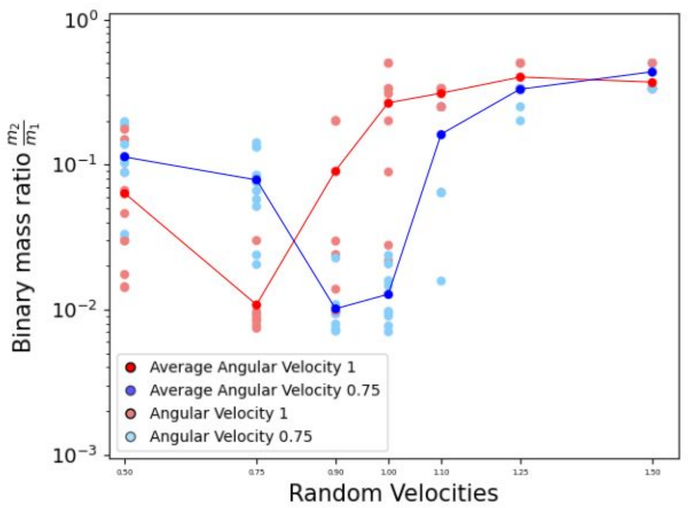


Figure 1. Comparing the Binary Mass Ratios against the Random Velocities. Here we have 10 run's (lighter shades) averaged into a singular trend (darker shades).

Figure 2

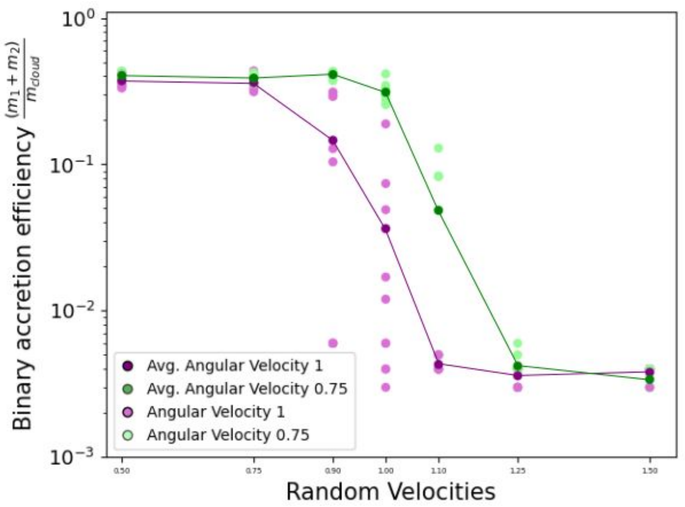
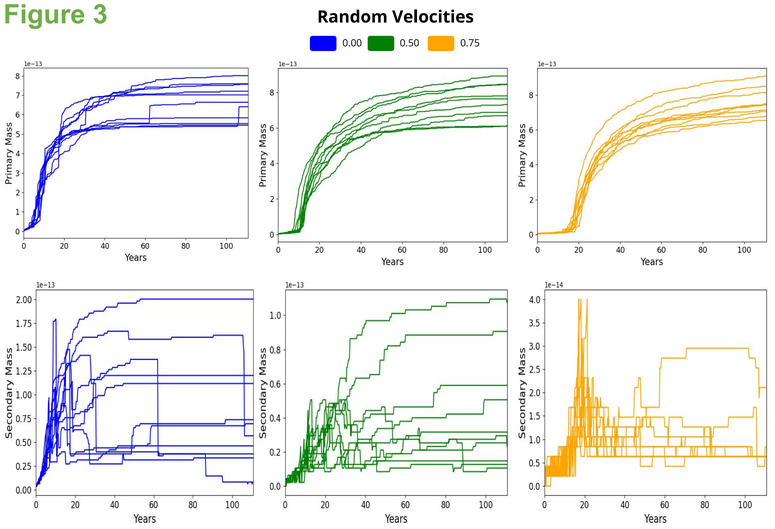


Figure 2. Comparing the Binary Mass Accretion Efficiency against the Random Velocities. Here we have 10 run's (lighter shades) averaged into a singular trend (darker shades).

Conclusions and What's Next

- In Figure 1, we noticed a decrease in higher rates, but as it got closer, it increased to establish a limit at a speed of about 1.50 (m/s).
- Looking at Figure 2, Binary Accretion Efficiency and noticed that the sharp decline we see happened at much higher random velocities than expected. This decline reaches a limit at higher velocities, around 1.50 (m/s).
- Onto Figure 3, when looking at the primary and secondary mass, the growth starts to be exponential, and then it plateaus as anticipated.
- Finally, we hope to do further energy analysis on this system to see the distribution of total energy of the particles over time to see the effects of our system even further.

Figure 3



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