Summer Research: Hypervelocity Globular Cluster

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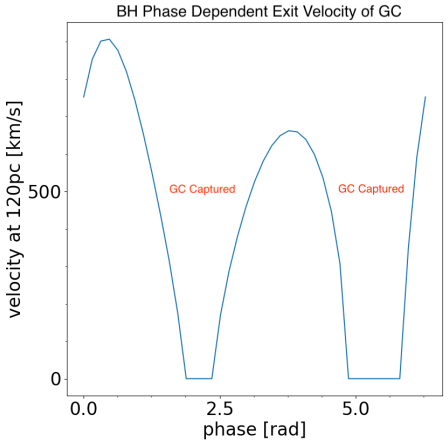
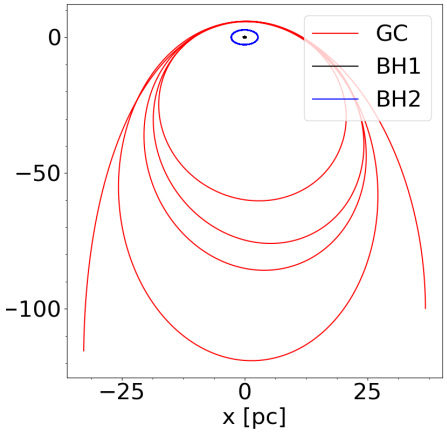
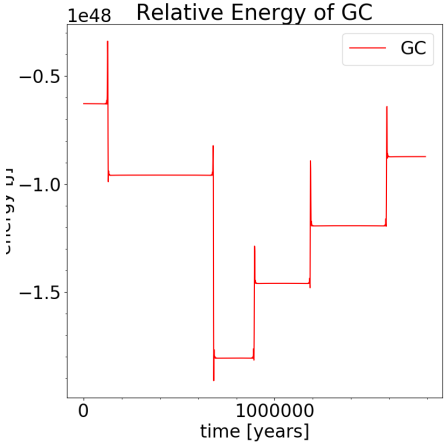
How BH phase affects ejection velocity

- Need to only consider phase-space that results in captured globular cluster.
- If the GC does not achieve a distance of 120 pc after infall or takes too long to get there (makes more than one pass) final velocity is set to 0 km/s.
- Some energy from GC is transferred to BBH when it is captured.

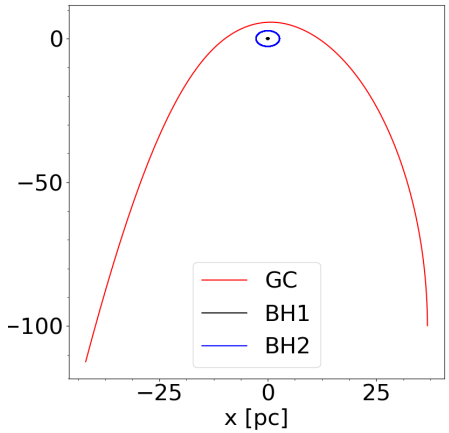


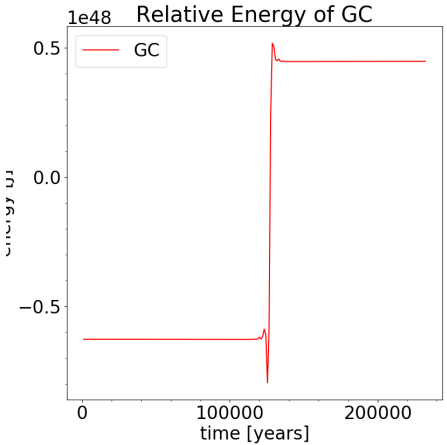
Energy Evolution of bound GC





Energy Evolution of unbound GC





Operational Parameters

- Input:
  - Black holes: Mass ratio (1:100, 1:20, 1:10), separation (1.7, 3, 5) parsecs
  - Globular Cluster: Closest approach (1.5, 2, 2.5) times BH separation
- For each combination of operational parameters, cycle through initial black hole phases 0 to 2pi in steps of pi/20. 1000 individual simulations, 7.5 min runtime.
- Outputs any velocity of ejected GC $>$ 1000 km/s, maximum tidal acceleration experienced, all operational params.
  (1108.74765364, 0.05, 1.7, 1.5, 0.785398163397)
- Interesting things: ZERO simulations with closest approach 2 or 2.5x BH separation and ZERO eith 0.01 BH mass ratio resulted in hypervelocity.

Analysis to find optimum path

- "Optimum path" meaning the interaction that results in highest ejection velocity and a low tidal acceleration.
- Want to find how far away from black hole binary the GC can get while still achieving a > 1000 km/s velocity:
  - Repeat simulation set with new operational parameters.
  - Calculate tidal radius & acceleration for each run.

Backup Slides

3:1 Mass ratio

- 2-3 pc pass from larger BH.
- Tidal radius of 0.3-0.4 pc