1 Description

- (Working) Title: The effects of binary stars on recovered remnant populations.
- Hypothesis/Research Question: So I think the goal is basically to see what the effects of realistic binary populations are on LIMEPY models and by extension, see what the effects on the recovered remant population are.
- Goals and Objectives: Create realistic binary populations, make some toy models to demonstrate the effects, fit models with realistic binary populations to observations, compare remant populations.

2 Motivation and Rationale

Our current, state of the art equilibrium models assume that all stars are single make no effort to include the effect of binaries.

Here maybe discuss a few studies that discss effects of binaries.

By including the dynamical effects of binaries in our models we hope to recover more accurate remnant populations in present day globular clusters. If there is a significant amount of mass in heavy binary systems, we may not need as much mass in heavy remnants to reproduce the observered kinematics of the cluster.

Binary populations in globular clusters are, in general, not very well constrained. Even for clusters for which we have large photometric surveys and multi-epoch radial velocity observations, we are often only able to observe binary systems with high mass ratios. This results in loose constraints on the total binary fraction and weak constraints on the mass ratio distribution above $q = 0.5$, with little to no constraints on the mass ratio distribution for $q < 0.5$. There are a few options in the literature for likely mass ratio distributions, the one with the most observational motivation being a flat mass ratio distribution where all value of q are equally likely. Other options include random sampling from the IMF or adopting the observed mass fraction distribution from the solar neighbourhood.

3 Methodology

Because of the high densities and old ages of globular clusters, we can safely assume that all long period loosely bound binaries have been ionized. This allows us to treat binary star systems as a single system for the purposes of our models, a binary system of two $0.5M_{\odot}$ stars should behave like a single star of $1M_{\odot}$. This means that in order to replicate the effects of binary stars in our models we can simply shift some of the stars from our binned mass function into bins of higher masses according to the binary population.

When we fit these modified models to observations, we need to take special care when comparing to the available stellar mass function data. The method used to collect the mass function data is to assume all observed stars are single stars and to assign each star a mass based on its luminosity. This means that when we compare our models to the data we will need to convert the dynamical mass of the binaries into an ”observed mass” which is related to the total luminosity of the binary system. These binary bins will then contribute to the single star bin which is closest to the ”observed mass” of the binary bin.

4 Timelime

- Basic reading and planning ✓
- Get the realistic binary populations working
  - Currently have it working with binaries defined by mass fraction ✓
  - Use the correct binary fraction so that we can compare to observations (1-3 weeks? less straightforward than I hoped)
- Project Summary (Nov 1st)
- Toy models (1-2 weeks)
- Use mass-luminosity relations to get the apparent mass of the binary system in order to fit on MF data (1-2 weeks)
- Modify the GCfit code to allow for the mass function to be fit to the observed mass of the binary system (I’m thinking this might be the longest part, maybe a few weeks?)
- Fit models (1-2 weeks, should easy once we modify GCfit)
- Literature Review (Ongoing - Jan 31st)
- Progress Report (Feb 7th)
- Thesis Draft (Ongoing - March 18th)
- End date (April 4th)