Testing Compact Binary Formation Models with Supernova Observations*

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I. INTRODUCTION

- Description of connections between stellar evolution, supernovae, and the mergers of compact objects.
- Population synthesis as a means of exploring how populations of these different phenomena and objects are linked to stellar astrophysics/evolution.
- Brief description of StarTrack.
- Consistency checks and fitting with StarTrack. Use known fractions and rates of the following to tune StarTrack and make sure it gives reasonable results:
  - Type II and Type Ibc.
  - Black-Hole-Wolf-Rayet systems: There are ∼10 of these known in our galaxy. These could be progenitors of BBH systems.
  - HR diagram
- Goal: After tuning, make predictions about other objects:
  - Type III SNe: We define Type III as failed SNe. That is, they collapse directly to black holes. In reality, there may be partial fallback of the matter ejected in the core collapse, so one idea is to differentiate between totally dark core collapse (IIId, 'd' for 'dark') and a partial fallback collapse which may be bright.
  - BBH systems that will be LIGO sources (duh!).
  - Number of black holes in our galaxy. Produce a catalog of black holes and also ask the simple question "What is the closest black hole to us?" This catalog will be useful for Gaia.

II. METHOD

- Description of StarTrack
- Description of how cosmological rates are calculated for SNe.
- Description of how MW rates of BH-WR binaries are calculated. e.g. Solar metallicity was used.
- HR diagram methods. We use solar metallicity to generate high-mass stars and evolve them. We then select a random time in each star's life to be the current time, and plot the star's luminosity and temperature at that time. In this way we can build up an HR diagram for high-mass stars.

III. CALIBRATION

- Results of SN predictions. See Figure 1.
- Results of HR diagram calculations. See Figure 2. We see few red supergiants, which is roughly in line with observations. Further tuning may be needed.
- Results of galactic BH+WR systems (in progress).

IV. PREDICTIONS

- predictions of the BBH, NSBH, and BNS rates. See Figure BBHMerger
- Discussion of number of Type III SNe. How many more of these should be seen by various facilities?

- Description of StarTrack model used (M10).

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* A footnote to the article title

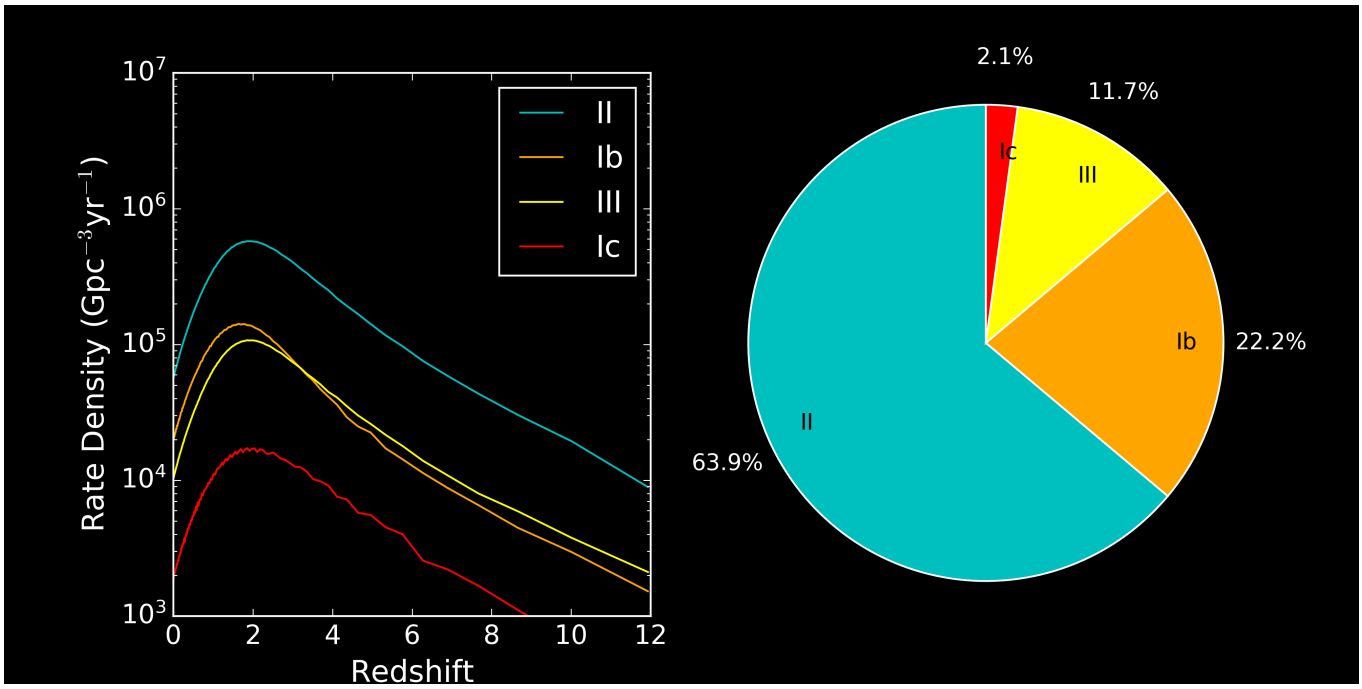

FIG. 1. Predicted cosmological rates of different types of SNe and their relative fractions in the local universe.

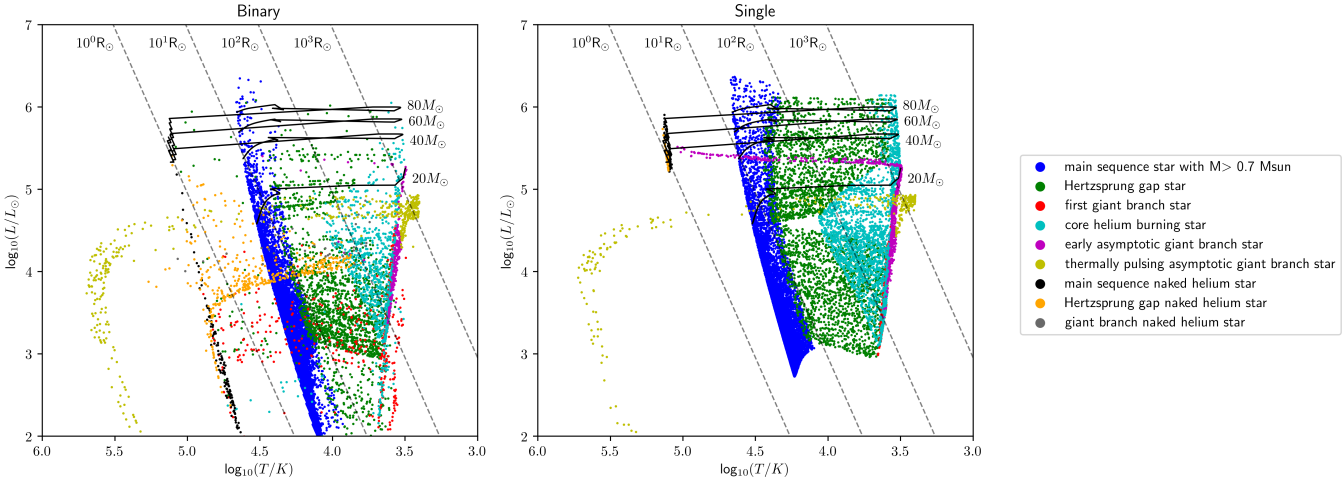

FIG. 2. HR diagram of binary (left) and single (stars) predicted by StarTrack for solar metallicity.

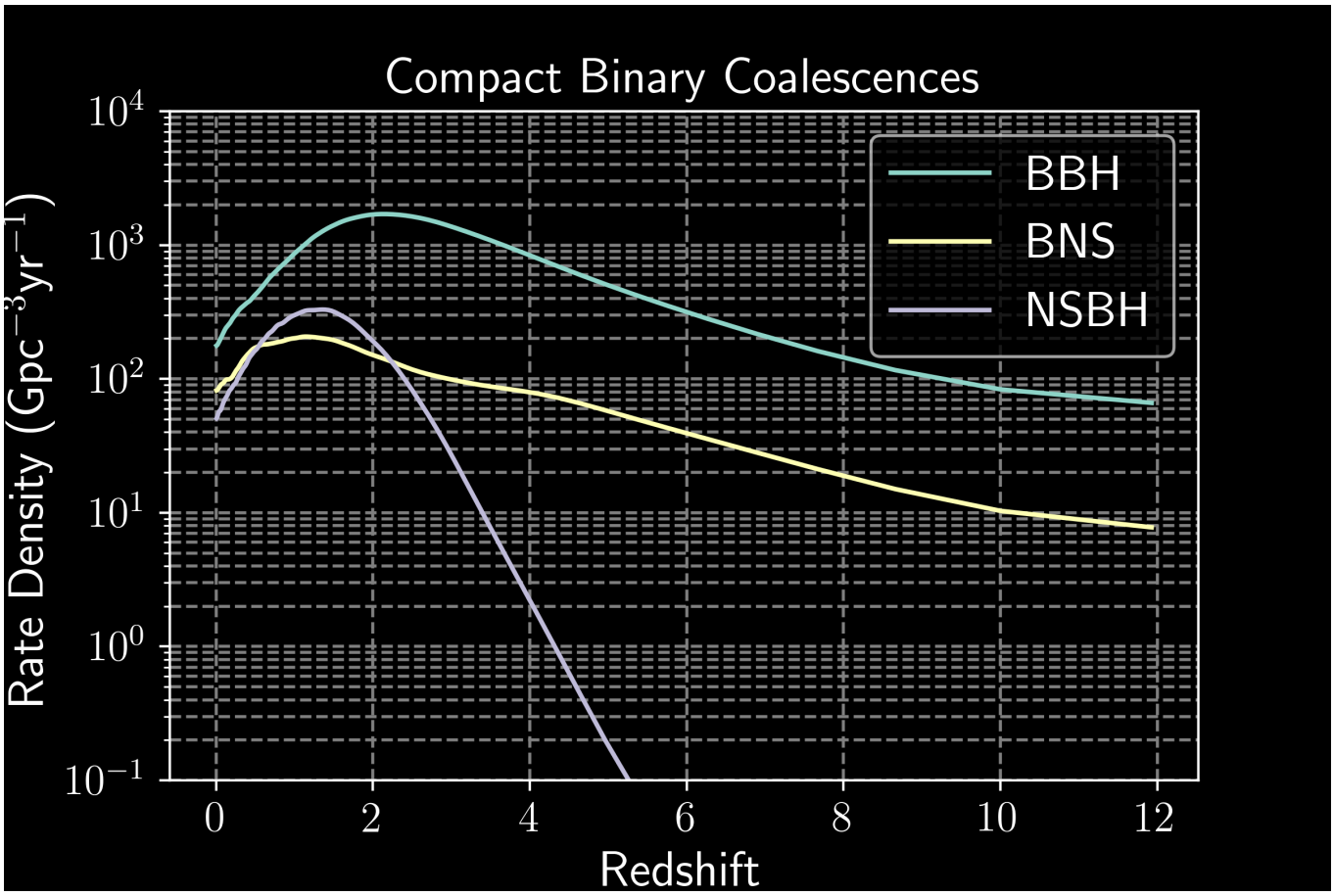

FIG. 3. BBH, NSBH, and BNS cosmological rates predicted by StarTrack using the M10 model.