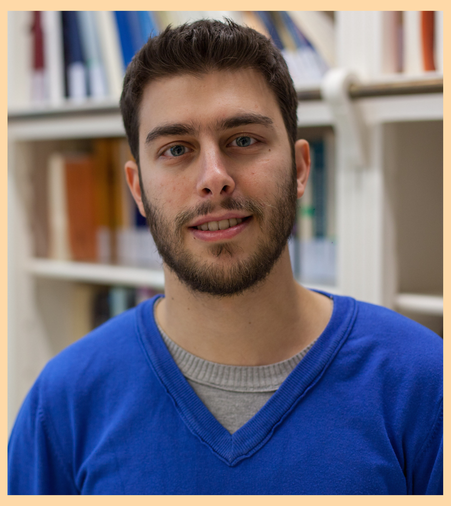

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What is the impact of binarity on the core collapse supernovae?

The delay time distribution

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1. Aim & Method

The majority of young massive stars are found in close binary systems[1]. We use a population synthesis code[2,3,4,5] to investigate the impact of binarity on the delay time distribution of core collapse supernovae (ccSNe). We distinguish between hydrogen-rich (type II) and stripped (type Ib/c) ccSNe.

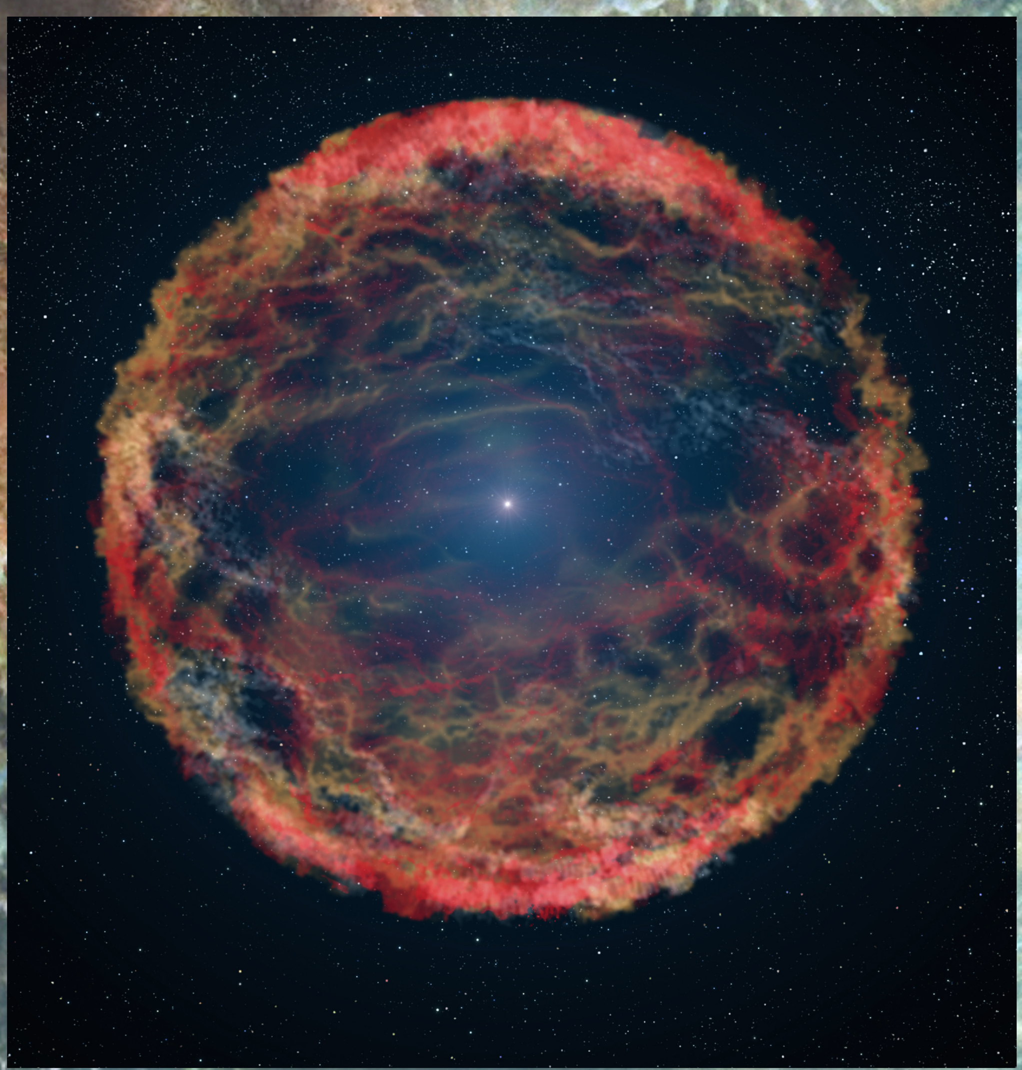
2. Questions

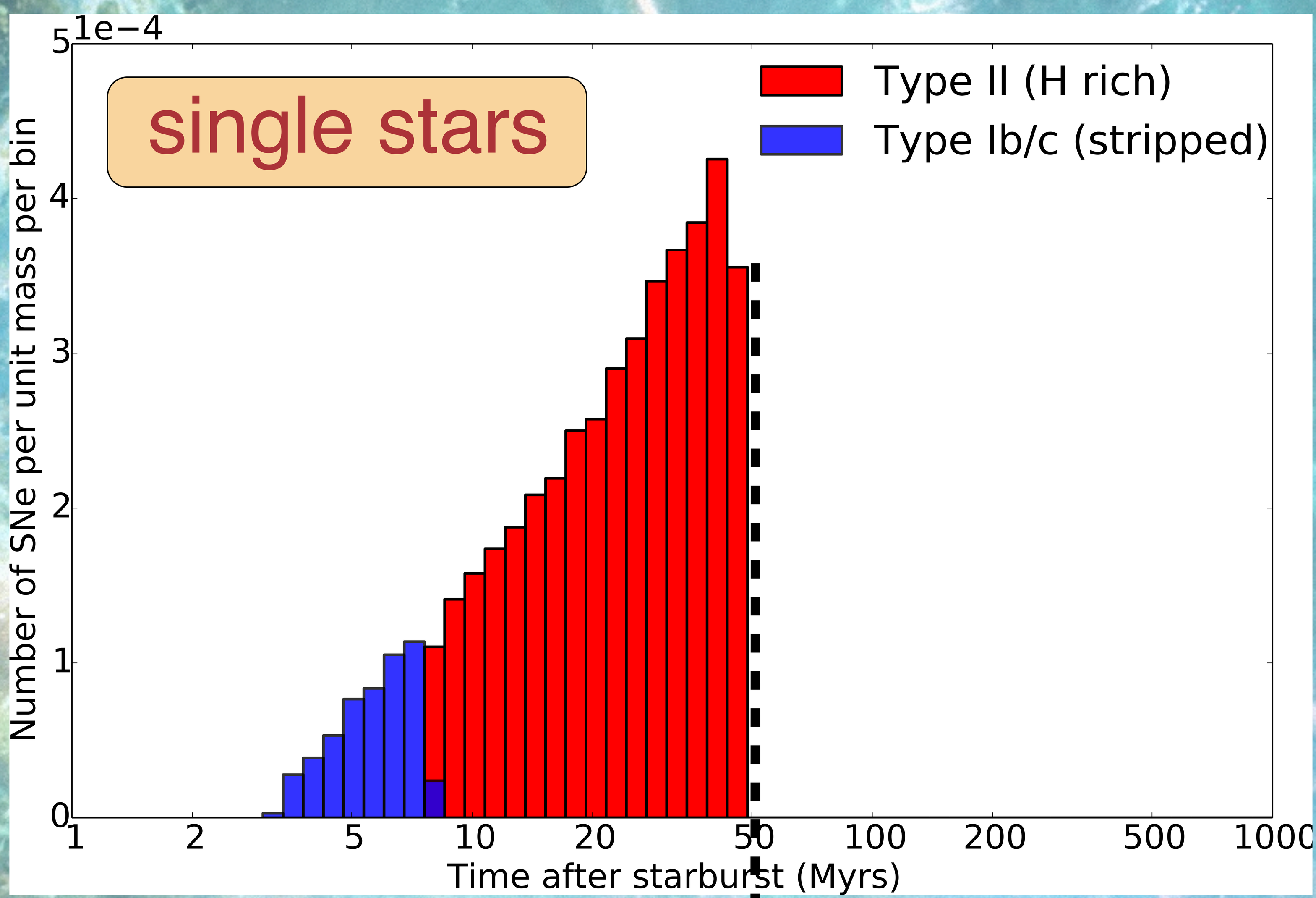
WHEN do ccSNe explode?

WHAT TYPE of explosion?

3. The delay time distribution

The delay time distribution of core collapse supernovae (ccSNe) is the distribution of ccSNe versus time after a hypothetical brief starburst. Below, on the top figure we show the delay time distribution for a population of only single stars, whereas on the bottom figure for a realistic population with 70% binary systems. The dashed line marks the end time of the distribution for the population of single stars.



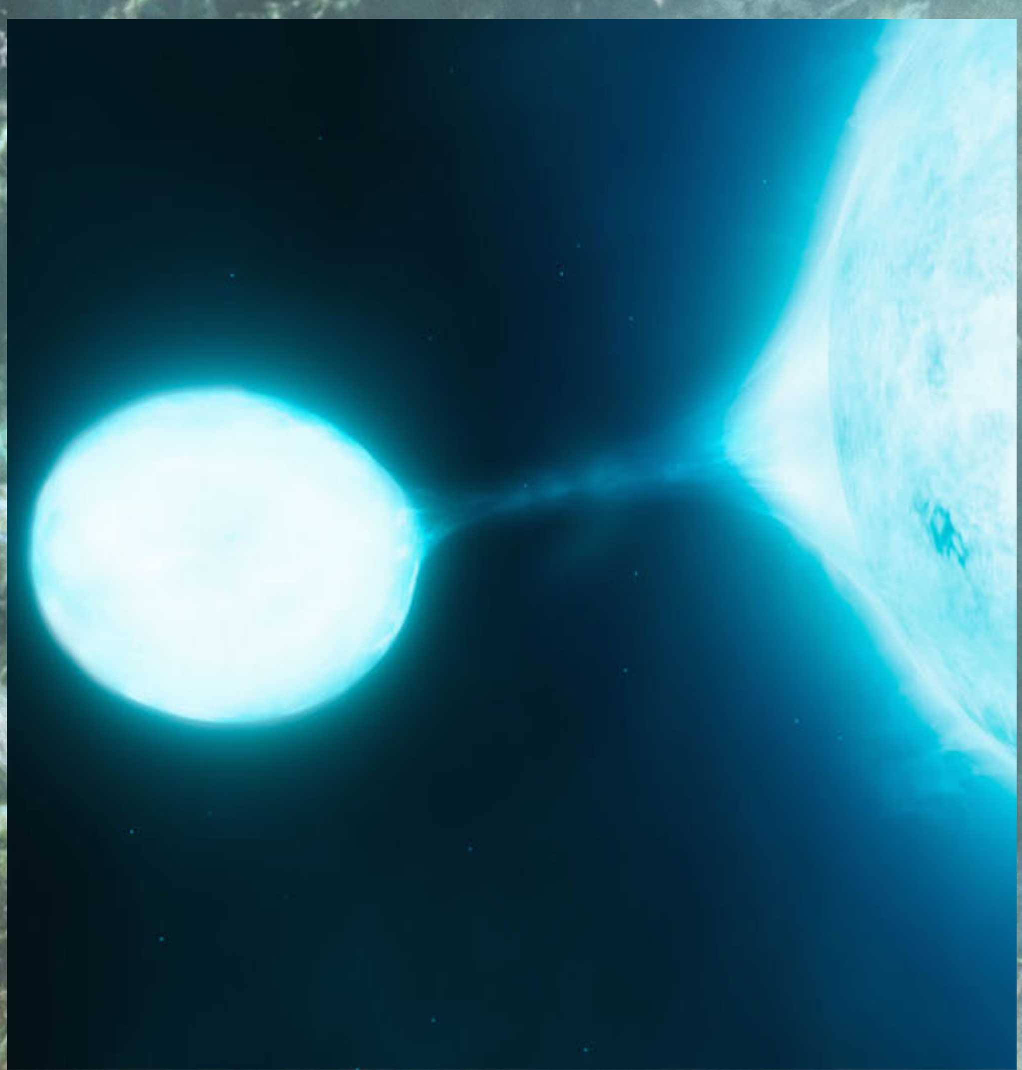


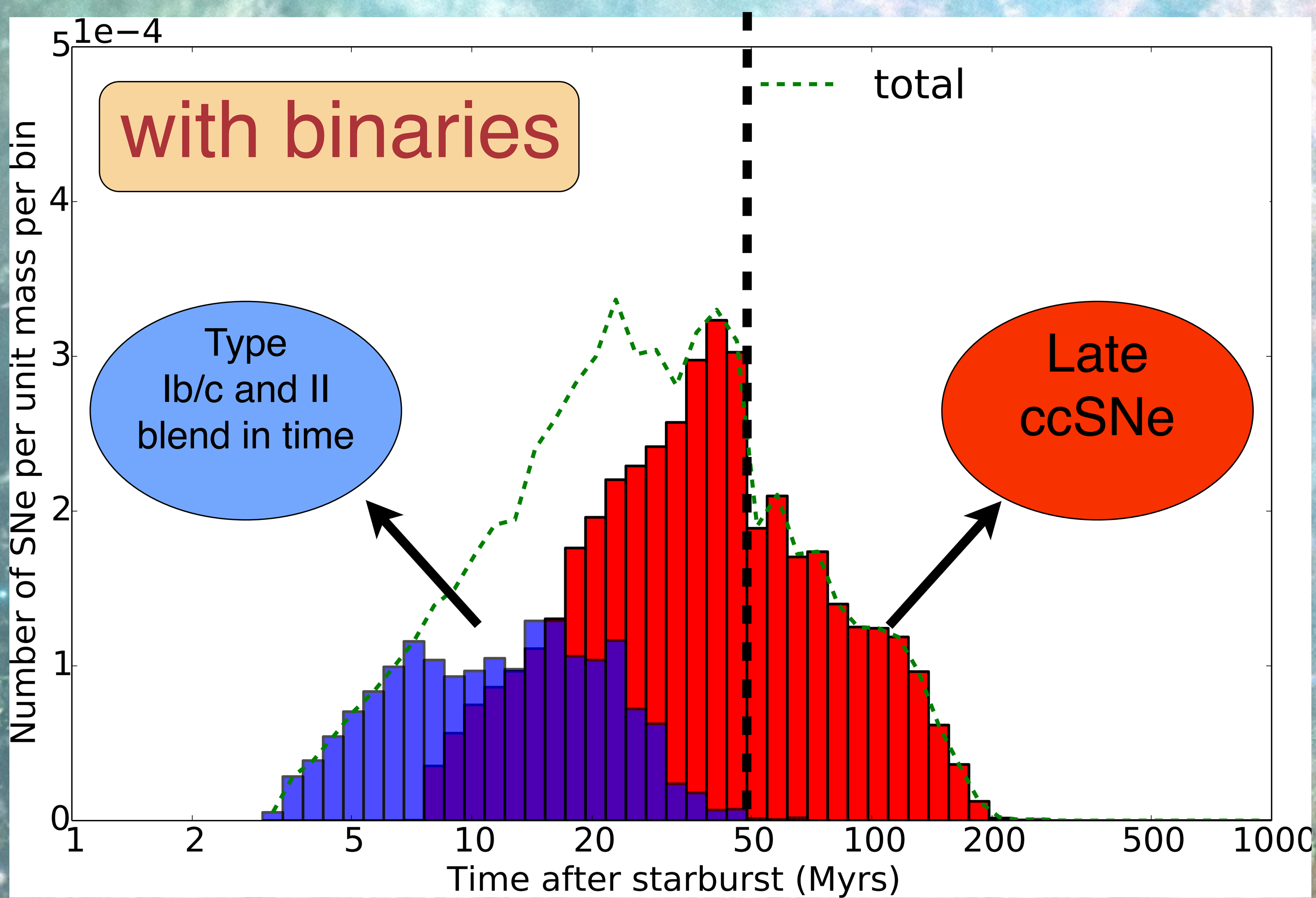
4. Results; single stars

✦The delay time distribution has a monotonous slope due to the Initial Mass Function.

✦The most massive stars (that are fewer) become Wolf-Rayet stars due to their strong winds and explode first as type Ib/c SNe.

✦There are no ccSNe after ~50 Myrs, which is the lifetime of the least massive star that can explode in a ccSN.





5. Results; with binaries

✦10-30% of all ccSNe are late, exploding after ~50 Myrs, when all single stars have already died. These late ccSNe originate mostly from intermediate mass stars that gained mass from a binary companion.

✦Type Ib/c SNe are blended in time with type II SNe. They may originate from stars that are not massive enough to evolve to Wolf-Rayet phase by getting stripped of their envelope due to mass transfer.

✦We get up to 30% more ccSNe for the same total mass in our population, compared to a population of only single stars.

✦The shape of the delay time distribution becomes more complex because different evolutionary channels may contribute to the same time bin.

6. Conclusions

✦The large majority of ccSNe originate from stars that have experienced binary interaction in the past, severely altering their properties. This means that the pre explosion images and other stellar quantities derived from the SN light curve and spectra no longer contain direct information about the birth mass of the progenitor star.

✦In a realistic population that includes binaries we get up to 30% more ccSNe, with the majority of them exploding late (>50 Myrs).

✦An observational signature of this late channel may be present in the delay time distribution inferred from supernova remnants in the Magellanic Clouds[6].

✦Population synthesis studies will provide a powerful tool for future comparisons with automated all-sky transient surveys.

References

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