Luminous Blue Variables and superluminous supernovae from binary mergers

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Evidence suggests that the direct progenitor stars of some core-collapse supernovae (CCSNe) are luminous blue variables (LBVs), perhaps including some `superluminous supernovae' (SLSNe). We examine models in which massive stars gain mass soon after the end of core hydrogen burning. These are mainly intended to represent mergers following a brief contact phase during early Case B mass transfer, but may also represent stars which gain mass in the Hertzsprung Gap or extremely late during the main-sequence phase for other reasons. The post-accretion stars spend their core helium-burning phase as blue supergiants (BSGs), and many examples are consistent with being LBVs at the time of core collapse. Other examples are yellow supergiants at explosion. We also investigate whether such post-accretion stars may explode successfully after core collapse. The final core properties of post-accretion models are broadly similar to those of single stars with the same initial mass as the pre-merger primary star. More surprisingly, when early Case B accretion does affect the final core properties, the effect appears likely to favour a successful SN explosion, i.e., to make the core properties more like those of a lower-mass single star. However, the detailed structures of these cores sometimes display qualitative differences to any single-star model we have calculated. The rate of appropriate binary mergers may match the rate of SNe with immediate LBV progenitors; for moderately optimistic assumptions we estimate that the progenitor birthrate is ~1% of the CCSN rate.

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