Type Ic Core-Collapse Supernovae Evolved from Very Massive Stars

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Very massive star

Super-luminous supernova (SL SN)

Core-collapse supernova (CC SN)

Pair-instability supernova (PI SN)

Pulsational pair-instability supernova (PPI SN)

Very Massive Stars



 M > 100M_o stars are identified in young starburst regions!
 e.g., 165-320M_o in R136 cluster 105-170M_o in NGC3603

Fate of very massive stars Supernova?, Blackhole formation?

Super-Luminous Supernovae (SLSN)



Type Ic SL SN 2007bi



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Explosion Mechanism of SN 2007bi

SN models reproducing light curve of SN 2007bi



PI SNe and PPI SNe



Final Fate of Very Massive Stars

Z=0.004 stars (TY & Umeda 2011, MNRAS 412, L78)





⁵⁶Ni Production of Aspherical CC SNe



Conclusions

Super-luminous supernovae

Some of them are expected to be evolved from very massive stars.
e.g. SN 2007bi: pair-instability (PI) SN or core-collapse (CC) SN?

Type Ic SNe with large ⁵⁶Ni production @ Z=0.004

- CCSN (PPI SN) with $M(^{56}Ni) \ge 3 M_{\odot}$
 - $110 \leq M_{\text{init}} \leq 280 \ M_{\odot}, E \geq 2 \times 10^{52} \ \text{erg}$
- PISN with $M(^{56}Ni) \gtrsim 3 M_{\odot}$



 $(M_{\text{init}} \ge 300 M_{\odot} \text{ with small mass loss rate})$

Aspherical CC SN models for SN 2007bi

≥ 250 M_{\odot} model, $E=7\times10^{52}$ erg: $\theta_{\rm op} \gtrsim 40^{\circ}$

110 M_{\odot} model, $E=5\times10^{52}$ erg: $\theta_{\rm op} \gtrsim 65^{\circ}$