Explosions inside Ejecta and Most Luminous Supernovae

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Discovery of the extremely luminous supernova SN2006gy \cite{1} has revived interest in SN models where light is produced by a long living radiative shock propagating in a dense circumstellar envelope. Those models were invoked earlier \cite{2,3} to explain unusual properties of other powerful supernovae with narrow emission lines in their spectra, SNIIn. SN2006gy also belongs to the same SNIIn class.

Spectra and light curves of SNIIn can be explained only when the number density of circumstellar matter at radii of $\sim 10^{15+16}$ cm (where the narrow lines are formed) is unusually high, like $10^{9+10}$ cm$^{-3}$. This implies a huge mass on the order of $M_\odot$ and more in the surrounding medium, which must be ejected within years, or sometime even months before the SN explosion.

Paper \cite{2} was the first to suggest that the SN in that case had a precursor, a relatively weak explosion, perhaps an order of magnitude weaker than a standard SN, ejecting a large slowly moving mass. A detailed spectral and hydrodynamic model for another SNIIn event has been presented in \cite{3}, and a concrete (pulsational pair-instability) mechanism of multiple SN explosions has been given in \cite{4} to explain SN2006gy. It works for high initial mass of the presupernova star $\sim 110 M_\odot$ (see Figure).

I point out acute problems arising in the theory of stellar evolution for other multiple-explosion SNIIn events where the presupernova mass was not so high. I discuss also important problems of the physics of supercritical radiative shocks. Strong X-ray emission of SNIIn near maximum light may be absent not only because it is absorbed: postshock temperature may be so low there that it does not attain keV range while inside the envelope.

References

\cite{2} E. Grasberg, D. Nadyozhin, Soviet Astronomy Letters, 12 (1986) 68.