

# Super-Luminous Supernovae and Shock Breakout in Dense Circumstellar Medium

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## Abstract

Recent supernova observations revealed the existence of super-luminous supernovae which are more than 10 times brighter than other kinds of supernovae. Most of super-luminous supernovae show narrow spectral lines which are interpreted as the emission lines from the dense circumstellar medium surrounding the supernova ejecta. Thus, the interaction between the dense circumstellar medium and the supernova ejecta is thought to be the cause of the high luminosity. Here, we show our numerical LC modeling of super-luminous supernova 2006gy by using a radiation hydrodynamics code STELLA. We show that, in the LC models which can explain the LC of SN 2006gy, the circumstellar medium is so dense that a radiation dominated shock wave appears in the dense circumstellar medium and it breaks out when the shock wave has reached the optically thin region of the circumstellar medium. After the breakout, the precursor appears in the circumstellar medium which makes the photosphere ahead of the shock and makes the supernova very bright.