N25a Light curve modeling of the extremely bright supernova 2016aps

Akihiro Suzuki (NAOJ), Matt Nicholl (University of Birmingham), Takashi J. Moriya (NAOJ), Tomoya Takiwaki (NAOJ)

The final fates of stars with initial masses more massive than several $10M_{\odot}$ have been paid great attention. Some of them are believed to end their lives as energetic core-collapse supernovae and leave stellar-mass black holes. Theoretical studies predict that even more massive stars with initial masses of $\sim 100M\odot$ or more would become unstable due to electron-positron pair production, leading to a variety of activities, such as extensive mass-loss and the complete disruption of the star. However, the observational consequences of such very massive stars are not clearly known.

In this work, we present the results of the light curve modeling of the recently discovered extremely bright supernova 2016aps (Nicholl et al. 2020). The spectrum and the total radiated energy of the supernova exceeding 5×10^{51} erg suggest that it is likely powered by the collision of massive and energetic supernova ejecta and massive hydrogen-rich circumstellar matter (CSM). The extreme nature of the supernova may shed light on the final evolutional path of very massive stars toward their violent deaths. We conducted the light curve modeling of SN 2016aps by 1D radiation-hydrodynamic simulations and found that the ejecta with $\sim 30M_{\odot}$ and 10^{52}erg and a $\sim 8M_{\odot}$ CSM extending to $\sim 10^{16}$ cm best explain the observed multi-color light curve. In this presentation, we report the results of light curve modeling and discuss the possible origins of this extremely bright supernova.