Abstract:

We present multiband photometry and spectroscopy for a Type II Supernova (SN) ZN7090 which displays a steep post-peak decline in its V-band light curve. Its pseudo-bolometric light curve also shows the same evolution post-peak, using statistical methods to quantify the morphology of the light curve and classify KSP ZN7090 as a Type II core-collapse (CC) SN. This uncommon morphology is product of the lack of H in the ejecta whose recombination causes the light curve to plateau. Furthermore, we constrain the rise time, and epoch of first light of the SN through multi-band simultaneous fitting which suggests that the power mechanism driving the rise of the light curve is shock cooling emission. Additionally, we use analytical expression for the bolometric luminosity and photospheric temperature derived by Rabinak and Waxman 2011 to simultaneously fit the monochromatic flux densities of ZN7090. However, the results of the fit indicated that the model did not agree with the observations as the is almost 50.

Optical Bands Light Curve

After performing image subtraction, PSF photometry, image stacking, color corrections and extinction corrections by Matthew Leung we observe the following monochromatic light curves

Pseudo-Bolometric Corrections

Bolometric light curves encapsulate the light from all emitted wavelengths, usually in the field of observational transients the observations range from the U to K bands. However, these observations tend to be rather expensive and difficult to conduct under the short time frame of the shock break out. For this reason, there has been several attempts at creating pseudo-bolometric corrections which can be applied to the color evolution of a SN in order to extract its bolometric magnitude.

For our study we have chosen to use the bolometric correction from Layman, Bersier, James, Mazzali, et al. 2016a for the (V-i) color. We note here that the color is a combination of Johnson (V) and Sloan (i) which are the filters used by the Korean Microlensing Telescope Network (KMTNet)

Monochromatic Flux Density Light Curves

We notice that some color data points are outside the effective range of the bolometric correction, which means these points are extrapolations. Therefore, for another way we can perform pseudo-bolometric fitting is if we were to fit the flux density light curves simultaneously with the same explosion/progenitor parameters, as this would simulate a pseudo-bolometric light curve and we would not be losing any important early data.

Explosion and Progenitor Parameters

Using the definition of the monochromatic magnitude system and the effective wavelengths for the respective bands (B,V,i) we calculate the flux densities per unit wavelength. Using the analytical expressions for temperature and bolometric luminosity we can derive the corresponding monochromatic flux densities.

The analytical expression only holds for the early stages of the light curve, particularly when the opacity is approximately constant and dominated by Thomson scattering which is at T > 0.7 eV. However, because we do not know the temperature, we will use other Type II CCSNe as reference which fit their light curves up until 11 days from the first light.

The results of the simultaneous fitting are physical and characteristic for red supergiant’s however, the reduced chi square for the fit is too high for us to claim our results hold any significance. We have observer the parameter space for 3 and 2 band fitting however, the chi-square is not good enough. New models need to be investigated as well as further confirmation on treating the early stage of the SN as a blackbody.