Early emission of Supernova 2016gkg

Keila Y. Ertini[1,2], Gastón Folatelli[1,2]

[1]Universidad Nacional de La Plata, Argentina

[2]Instituto de Astrofísica de La Plata, Argentina

Introduction

With an unprecedented discovery, Type IIb supernova (SN) 2016gkg, was detected briefly after the explosion. This resulted in a wide temporal and photometric coverage and made possible the first consistent modeling of a SN light curve from shock breakout. Such event motivated us to develop a code that calculates the bolometric light curve by two different methods that will be useful in the future to apply to other SNe: black body fits and UVOIR flux adding extrapolations. We paid special attention to the early phase, since in latter phases, when the radioactive heating of Niquel starts to gain importance, all effects of the progenitor star in the light curve will be gone. We present here the obtained bolometric luminosities. In order to compute the bolometric corrections and to compare with other SNe, we made the analysis with the luminosity obtained from the UVOIR flux + extrapolations since the lack of IR data made the black body fits less reliable.

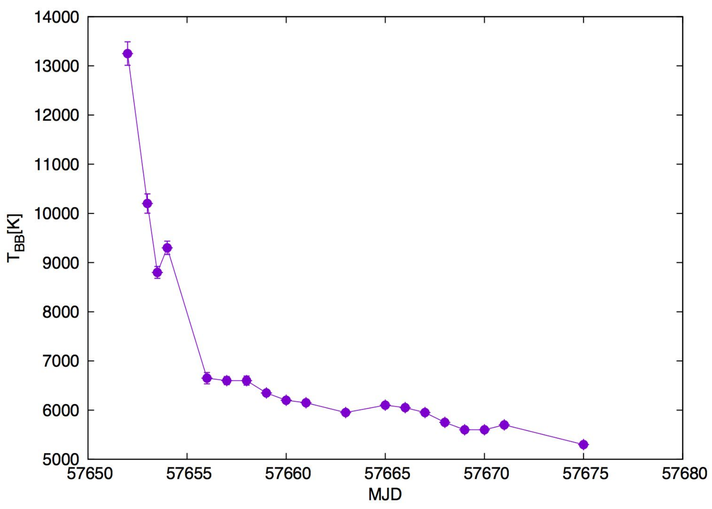
Data sample

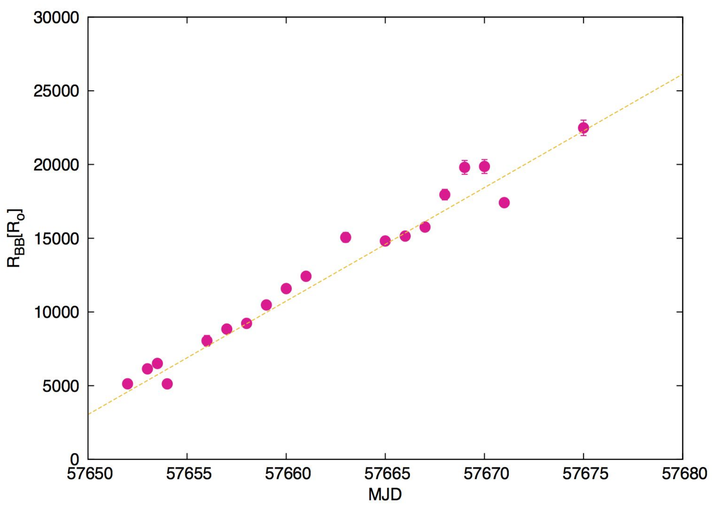
For this work, two different data sets have been used. The first one consisting of *B*, *V* and *I* filters (Bersten et al., 2018) and the second one composed of observations from Swift Space telescope in the filters UVW2, UVM2, UVW1, u, b and v (Tartaglia et al., 2017). We interpolated the light curves to achieve a good coverage, and we obtained a good sampling until 23 days after explosion.

The spectral energy distributions (SEDs) were constructed by calculating firstly, each filter's effective wavelength and then by transforming the observed magnitudes into specific fluxes.

Black body fits

Black body distributions were fitted to the SEDs by covering a grid of temperature and angular size and then were weighted to obtain the best adjusted parameters for each epoch.





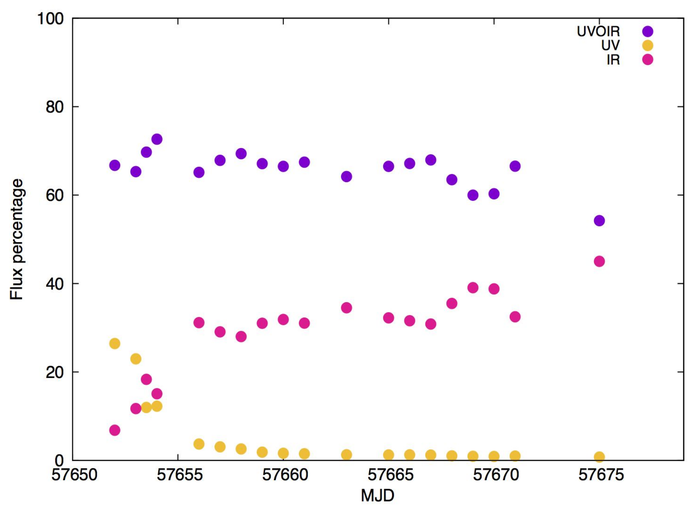
Evolution of the fitted BB temperature and radius.

Photospheric velocity
***V* ~ 6300 km/s**

Integrated flux

The *UVOIR flux* was obtained by integrating the observed flux in the available bands. With the purpose of taking all bands into account and not underestimating the flux, we add extrapolations.

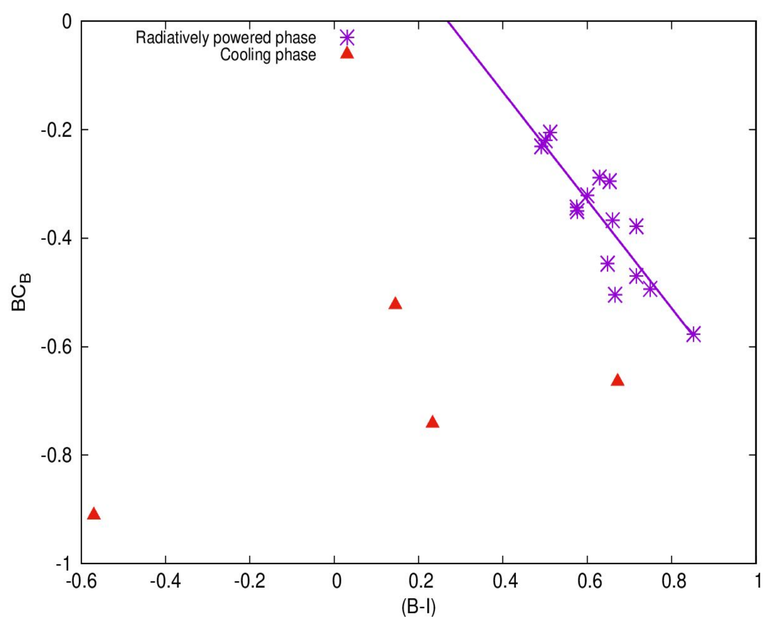
- **UV flux:** linear extrapolation was made from zero Å to UVW2 filter.
- **IR flux:** black body fits were made and then they were integrated from I filter to 10000 Å, when we consider IR emission not significant.



Behaviour of UV, UVOIR and IR flux as functions of the total flux.

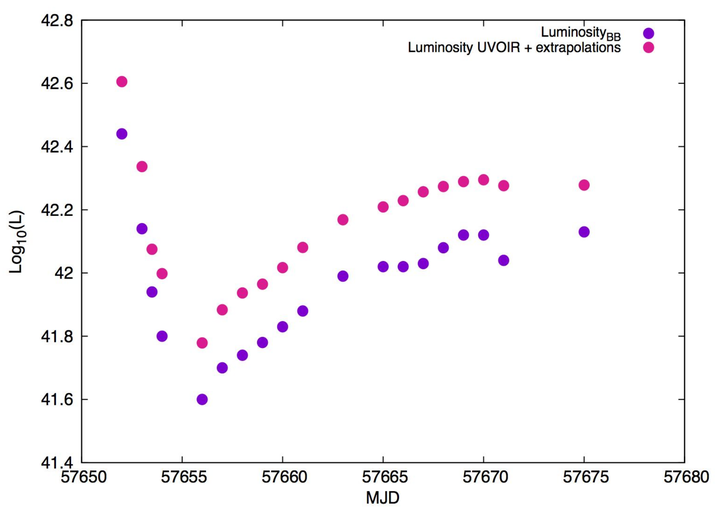
Bolometric corrections

From the bolometric luminosity, we were able to calculate the bolometric corrections.
Two different behaviours were observed for the cooling phase and for the radiatively powered phase.



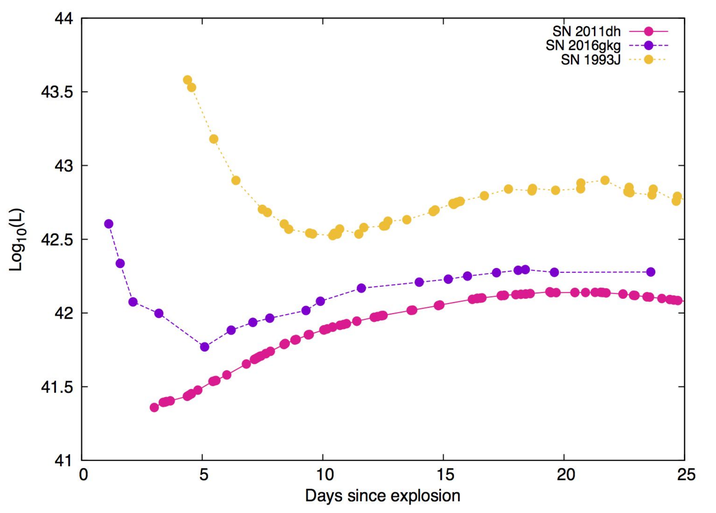
A fitted curve to our radiatively powered phase data is shown, as in Lyman et al., 2014.

Bolometric luminosity



Bolometric luminosities calculated from black body fits (purple) and from integrated flux + extrapolations (pink).
We consider *extrapolations + UVOIR* to be more reliable given the deviation of the SED from a black body.

Comparison with SN 1993J and SN 2011dh



Progenitor radius of SN 2016gkg intermediate to those of SN 1993J (Richmond et al., 1994) and SN 2011dh (Ergon et al., 2014).

Conclusions

We were able to calculate the bolometric luminosity, giving special attention to the cooling phase.
Given the recent increase in the amount of immediate data after explosion, we expect to apply this code in the near future to other SNe in the early phases.

References

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Ergon et al., 2014, A&A, 562, A17
Lyman et al., 2014, MNRAS, 437, 3848
Richmond et al., 1994, AJ, 107, 1022
Tartaglia et al., 2017, ApJ, 836, L12