Supernova Environmental Impacts
Proceedings IAU Symposium No. 296, 2013
A. Ray & R. A. McCray, eds.

doi:10.1017/S174392131300968X

V-band light-curve morphologies of supernovae type II

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Abstract. We present an analysis of V-band light-curves morphologies of type II supernovae (SNII). This investigation is achieved through photometry of more than 100 SNe including a first analysis of SNII data obtained by the Carnegie Supernova Project (CSP). We define the important observables and present correlations between SNe absolute magnitudes and light-curve decline rates: we find that brighter SNII tend to have faster declining light-curves at all epochs.

Keywords. (stars:) supernovae: general

1. Introduction

The original spectroscopic classification of SNe into types I and II was based on the detection of hydrogen (Minkowski 1941). It is now believed that hydrogen rich SNII arise from the core-collapse of massive stars which explode with a significant fraction of their hydrogen envelopes retained. However, SNII show a wide range of light-curve properties from the steeply declining linear; SNIIL, to the more abundant plateau; SNIIP (Barbon, Ciatti & Rosino 1979). In these proceedings an initial analysis of the diversity of V-band light-curve morphologies is presented for a sample of 118 SNII obtained through the Carnegie Supernova Project (CSP), together with earlier follow-up campaigns.

2. SNII V-band light-curve correlations

In figure 1 (left panel) the defined light-curve measurements are displayed. Three magnitudes are defined: Mmax, the maximum magnitude; Mend, the magnitude at the end of the 'plateau'; and Mtail, the magnitude at the start of the radioactive tail. Three decline rates are also defined: s1, the initial decline from maximum; s2, the 'plateau' decline; and s3, the decline rate of the radioactive tail. Distributions of these values are built and correlations between the various parameters are investigated.

It is found that the magnitude at the end of the 'plateau', a value often used for SNII studies in the literature, does not corelate with decline rates. This is shown in the right panel of fig. 1. However, as shown in fig. 2, Mmax does correlate with SN decline rates: brighter SNe decline more quickly both during the 'plateau' and during the radioactive tail. This second correlation is intriguing as it implies that brighter SNe decline more quickly than that expected from the decay of ^{56}Co, which is believed to power the light-curve at late times. If this result is verified then it would constrain the mass and density of the ejecta of bright more linear SNe, to be significantly lower than that of dimmer SNIIP.

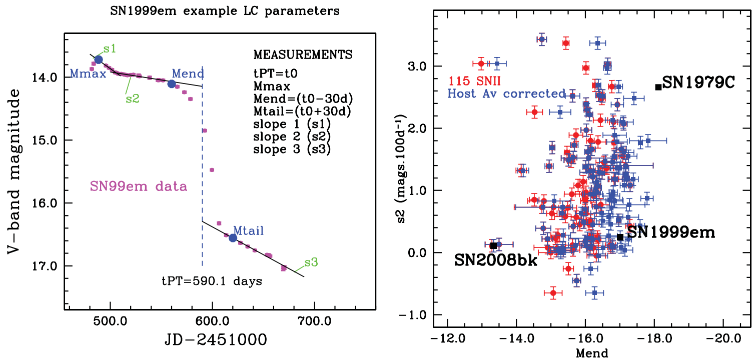

Figure 1. ***Left***: Schematic showing the defined SNII light-curve parameters for measurement: three absolute magnitudes; Mmax, Mend and Mtail, plus 3 decline rates; s1, s2 and s3. ***Right***: Correlation between Mend and s2.

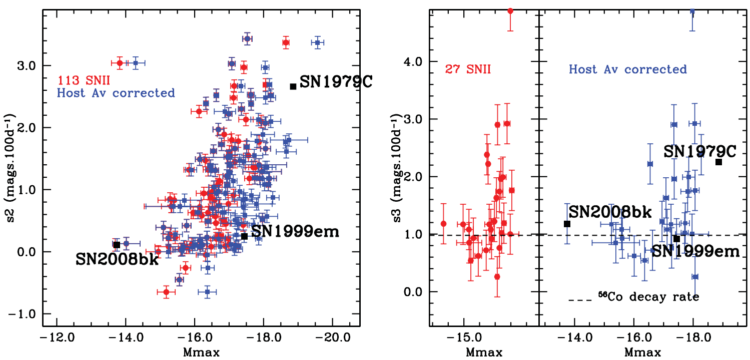

Figure 2. ***Left***: Correlation between Mmax and s2. ***Right***: Correlation between Mmax and s3.

3. Conclusions

In this initial study of SNII light-curve diversity it has been found that brighter SNe (at maximum) decline more quickly at all epochs. This can be rephrased to say SNIIL are in general more luminous than SNIIP, as has been suggested previously by Patat *et al.* (1994). However, here we vastly increase the statistics finding a continuum of events from low luminosity SNe which rise during s2, through to luminous SNIIL which decline quickly. The full analysis of this sample will provide further constraints on the diversity of SNII events, and the physical differences which drive differences in their transient evolution.

Acknowledgments: J.A. acknowledges support from FONDECYT grant 3110142, and grant ICM P10-064-F (Millennium Center for Supernova Science), with input from ‘Fondo de Innovacin para la Competitividad, del Ministerio de Economa, Fomento y Turismo de Chile’.

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