

## PHOTOMETRIC SUBLUMINOUS TYPE IA SUPERNOVAE

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We present a new photometric identification technique for subluminoous type Ia supernovae capable of selecting out this subgroup from the normal type Ia population. The technique reveals that a proper subluminoous definition needs to include color besides light-curve width. Furthermore, it can be used to identify a variety of newly discovered peculiar type Ia supernovae demonstrating photometric similarities between these different objects.

Type Ia supernovae (SNe Ia) have been used as cosmological distance indicators to measure the expansion rate of the universe (Riess et al. 1998, Perlmutter et al. 1999). Despite this, the nature of the progenitor system and explosion remain under debate. In particular, several SNe Ia with peculiar light-curve shapes, colors and spectral features such as subluminoous “91bg”-like objects have been left out of cosmological studies but are a key part to understand the SNIa mechanism.

We use SiFTO (Conley et al. 2008) light-curve template fits to fit a large low- $z$  sample with two different templates: a normal SNIa template from Hsiao et al. (2007) and a subluminoous SNIa template from Nugent et al. (2002)<sup>2</sup> (see Figure 1). We choose the best fitting according to the quality of the fitting ( $\chi^2$ ) and find an excellent agreement with spectroscopic identifiers such as SNID (Blondin & Tonry 2007) and the classification scheme of Branch et al. (2006) or Wang et al (2009). The method shows that besides light-curve shape, color is also required to differentiate subluminoous SNe Ia. Additionally, it permits to identify other groups of peculiar SNe Ia, like the so called “Iax” (e. g. Foley et al. 2013), super-Chandrasekhar SNIa candidates (e. g. Yamanaka et al. 2009) and a new emerging class of objects with subluminoous characteristics but wide light-curve width (Maguire et al. 2011). This argues for strong observational resemblance and point towards yet unexplored similarities in the explosion and progenitors of different “peculiar” SNIa groups.

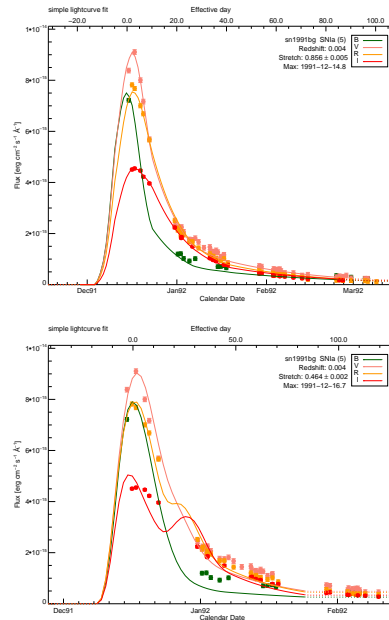


Fig. 1. Example light-curve fits for SN 1991bg with SiFTO using a normal SNIa template (left) and a subluminoous SNIa template (right). The fit is better with a subluminoous template.

This photometric technique proves to be a powerful tool for current and future large surveys of several thousand of transients in which spectroscopic follow-up of all objects becomes impossible.

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<sup>2</sup>[http://supernova.lbl.gov/~nugent/nugent\\_templates.html](http://supernova.lbl.gov/~nugent/nugent_templates.html)