CfA Supernova Ia Light Curves

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Type Ia supernovae are central in measuring the accelerated expansion of the Universe and the properties of the underlying dark energy. Nearby SN Ia are compared with distant ones to establish the history of cosmic expansion. In fact, current efforts in SN Ia cosmology are constrained by the limited number of well-observed nearby SN Ia. A significantly improved sample of nearby SN Ia, fully covering the space of Ia properties, is needed to maximize the utility of high-redshift SN Ia. Our ongoing project at the CfA has collected such a set of 150 SN Ia. We are reducing this sample and present 80 preliminary Ia light curves in figure 1. We give highest priority to peculiar Ia's so as to better determine the whole range of Ia's. One example is SN 2006gz (see fig. 1), a slow-decliner that does not show a large secondary peak in *i*-band. In coming months we will use our large set of Ia's to compare and combine with existing samples to better understand the homogeneity and diversity of Ia properties and more precisely determine the expansion of the Universe.

Over the past 6 years we have gathered *UBV RI/ri* photometry for over 200 SN of all types, using the KeplerCam and its 2 predecessors on the FLWO 1.2m. In addition to optical photometry, we get well-sampled NIR photometry and optical spectroscopy for many of our SN. Approximately 70% of these SN are Ia, 15% Ib/c and 15% II. When published, our light curves will roughly double the local sample of all 3 types. During the 2005-06 season we greatly expanded our number of nights on the sky. Combining that with generous service observing by the Kepler SCP Team, during the time of night when their fields were set, over 80 SN (54 Ia's) were observed during 2005-06 and with similar cooperation we are on pace to observe over 100 (70 Ia's) during 2006-07. Within 3 years we plan on having a sample of ~200 SN Ia that were all observed with the same instrument, Keplercam.

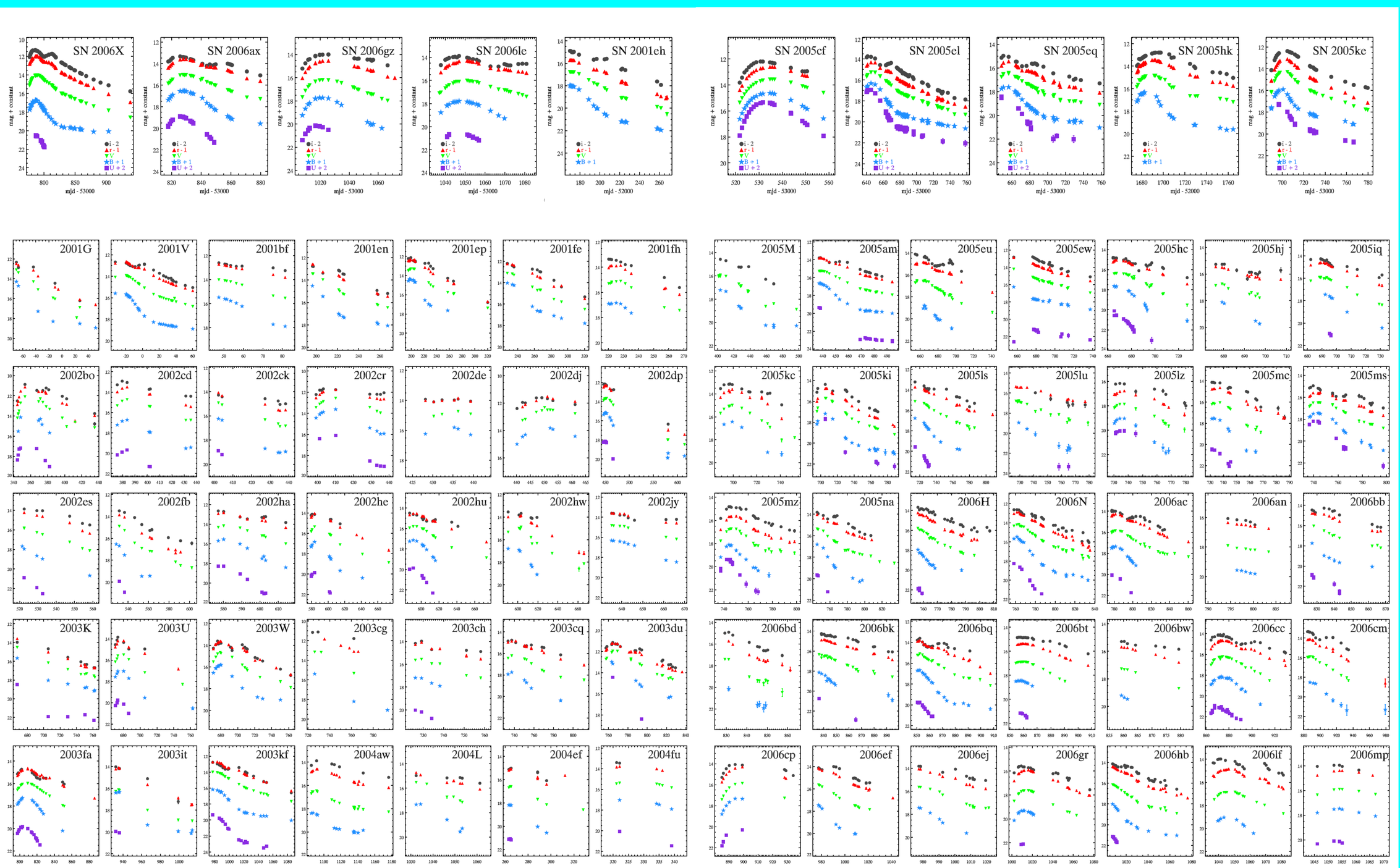

Figure 1: 80 CfA Light curves from 2000-2004 ($UBVRI$) and 2004-2006 ($UBVri$)

SN Ia Decline Rate v. Host Galaxy Properties

It is well-known that maximum brightness in *B*-band correlates with the decline rate of SN Ia. Additionally it has been seen that overluminous Ia's are found in later-type galaxies over a wide range of projected galactocentric distances (PGCD) while very-fast declining, subluminous Ia's are found in earlier type galaxies and are not often found at large PGCD (e.g. Hamuy et al. 2000). It should be noted that PGCD is only a lower limit on the actual distance between host center and SN. With a new and independent set of Ia's, we confirm this trend. In fig. 2 we have calculated the decline rate for 63 new Ia's from the fig. 1 CfA light curves and plotted them against their host galaxy morphology and projected galactocentric distance. The color-coding highlights that indeed the fastest decliners (in red) are in elliptical and early-type spirals with low PGCD while the slow decliners (in blue) are found at a wide range of PGCD and only in later-type spirals and irregulars. No very-fast decliners are found in our later-type hosts. The peculiar SN 2005hk (in black, and possibly in a new class of Ia's with the similarly peculiar 2002cx, see Phillips et al. 2006), has a moderately-fast decline rate, but is in an SABd host. Overluminous SN Ia tend to occur in younger stellar populations while subluminous SN Ia tend to occur in older populations. Comparing a larger set of SN Ia light curve properties with more quantitative measures of host and local environment characteristics may be useful in understanding SN Ia progenitors.

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References
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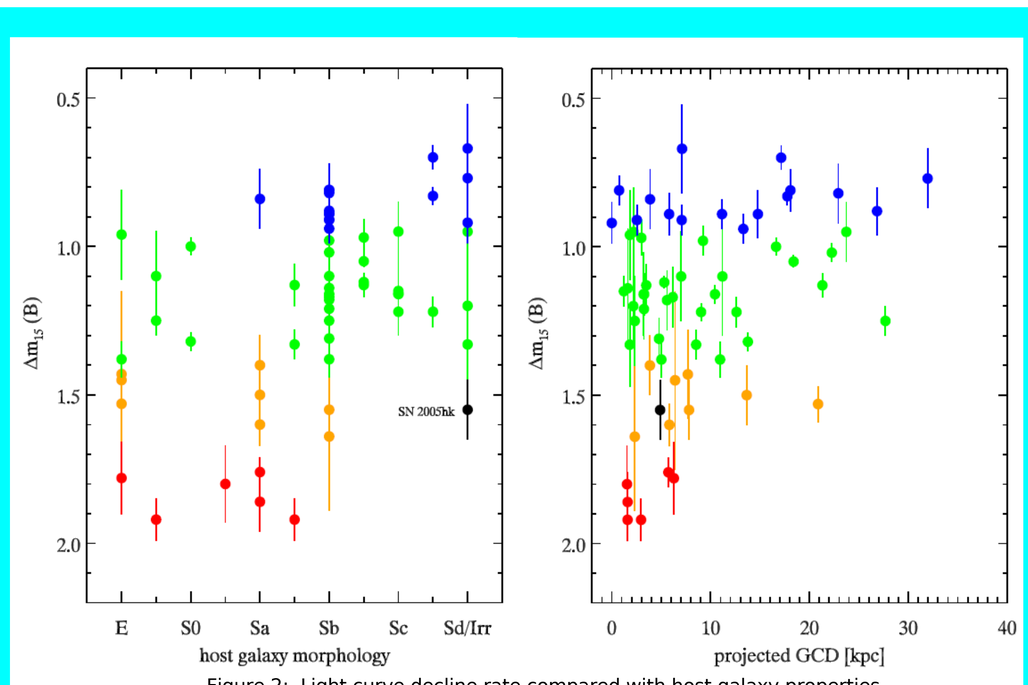

Figure 2: Light curve decline rate compared with host galaxy properties